# SCIENCE

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## THE DEPENDENCE OF PROGRESS IN SCIENCE ON THE DEVELOPMENT OF INSTRUMENTS[1]

OUR civilization is requiring for its physical welfare a more and more intimate knowledge of nature's forces. It is demanding this knowledge faster than it is being produced as a by-product in our educational institutions. Scientific investigation is becoming a large business. Governments have established research laboratories; private individuals have endowed others; universities are making more strenuous efforts than ever to encourage research and to make it a real part of their function; and commercial enterprises are finding it profitable to establish research laboratories on a large scale, not being able to wait for the random discoveries from other sources. These facts, alone, show that science is rendering an indispensable service.

The factors which are involved in the solution of scientific problems are in part mental and in part physical. Long experience has taught that however much we may owe to the great minds that evolve basic generalizations and hypotheses, real progress in science ultimately rests on the establishment of facts. Our reasoning faculties, by themselves, are unable to cope with the complexity of the physical world, and are sure to stray from reality unless they are continually guided by observation and experiment. Galileo with his experimental methods contributed more to sci-

[1] Address of the vice-president and chairman of Section B—Physics, American Association for the Advancement of Science, Columbus, December, 1915.

ence than did all the generations preceding him.

Observations made with our unaided senses limit us to the most superficial aspects of natural phenomena; but when we bring scientific instruments to our aid, we throw off these limitations. Not only are we enabled to observe more accurately and more systematically all that our senses ordinarily perceive, but we become endowed with new senses that open up fields of knowledge of which otherwise we could not even have dreamed. This broadened vision constantly brings to light new problems for solution, necessitating new methods and greater refinement.

The greater the advancement in any branch of science, the greater must be the development of the apparatus that is employed. The two are necessarily interdependent. The instrument is to a great extent an index of the state of the science. The greater the precision with which we can make our observations and measurements, the surer we are of keeping on the right path in our interpretation of the phenomena concerned.

I desire to lay some emphasis on this close relationship that exists between the evolution of our ideas and the development of instruments used in science, and I wish to make some suggestions as to how greater efficiency in our work may be attained.

My first purpose will be accomplished by some citations from the history of our science. Let us first recall some simple cases in optics.

Converging lenses are said to have been found in the ruins of Nineveh and must have been made long before the manufacture of glass. They were certainly used at an early date by the Greeks. But the discovery of the combination to form a telescope was not made until 1608; and Galileo soon after constructed telescopes magnifying 30 diameters, which at once led him to important discoveries. The compound microscope originated at about the same time. Without achromatic lenses, both of these instruments were very imperfect. The possibility of making an achromatic lens occurred to Newton, but reliance on a single unfortunate experiment led him to discard the idea. The construction of such lenses by Dollond, in 1757, marks the beginning of a great epoch in the development of optical instruments. It is only necessary to mention the gradual development of various combinations of lenses to bring to mind a great array of most important discoveries which they have made possible, not only in physics, but also in astronomy, in biology, in medicine, and in every natural science.

The pin-hole camera, which led to the idea of photography, was devised in the second half of the sixteenth century. After the image was rectified by means of a mirror and its sharpness and brightness increased by substituting a lens for the pin-hole, this was used quite generally by landscape painters. What flight of imagination to believe that that observed image could ever paint itself! If the idea occurred to some it was brushed aside as a fancy and a dream. Such an accomplishment must forever be beyond the reach of man! No manipulation of machinery could bring about such a marvel. No known forces of nature could be employed. But, as often happens, means were soon found, and what had been considered impossible was realized.

Even before the discovery of the camera obscura the alchemist Fabricius (1556) made silver chloride, and observed that light blackened it. He found that an image of an object imprinted itself upon it. This had no significance to him, how-

ever, and the discovery, although published, was for the time forgotten. More than two hundred years later (1777), Scheele made images imprint themselves on paper that had been saturated with a solution of silver chloride, but these images disappeared when exposed to light. Finally, Niepce, in 1827, produced permanent photographic pictures on metal, and Daguerre improved the method in 1839.

Becquerel and Draper in 1845 independently photographed the Fraunhofer lines, this being the first application of photography to scientific research. Since that day photography has become one of our important new senses and an indispensable instrument of research. Even the long-sought color photography is now a reality.

Spectroscopy presents a good illustration of our subject. That rainbow colors are produced by edges of glass plates was known from the beginning of the Christian era. Glass prisms were manufactured in the seventeenth century, and attempts made to explain the production of the colors resulted in the solution given by Newton, in 1672.

Wollaston, in 1802, observed seven dark lines in the solar spectrum, but Fraunhofer by making larger and better prisms and by using a telescope was enabled to see "countless" numbers of them. He also discovered the bright line spectrum of sodium, superposed, however, over the continuous spectrum of the heated carbon particles present in the flame. He was also the first to make and to use the diffraction grating and to measure the wave-length of sodium light. No explanation of the dark solar lines was given, however, for forty years. After the invention of the Bunsen burner in 1857 many substances could be easily vaporized, and spectral lines were obtained free from the continuous spectrum which confused previous experimenters. Thus spectrum analysis was developed, and the true nature of the dark lines in the solar spectrum soon afterwards demonstrated. The possibility of detecting the motion of stars by the shifting of the spectral lines was considered. This, however, could not be done with the instruments then available. Nothing more could be accomplished until diffraction gratings were much improved.

The original gratings had been constructed of wire, and later they were made with scratches on glass. These were soon perfected sufficiently so that in 1868 Huggins detected the shifting of the dark lines in stellar spectra, beginning a new era in the study of astronomy. The further perfection of these gratings has been most remarkable and the results obtained with them of the highest importance. Even now we feel the need of a still higher resolving power. The problem was, and still is, to get the lines equally spaced with sufficient accuracy for a large number of successive lines. In about 1870, the Nobert gratings, previously used, were replaced by those of L. M. Rutherfurd (1816–1892), who finally made gratings on speculum metal, with a resolving power of 10,000. Rowland (1841–1901) then succeeded in making gratings with a resolving power of 150,000, which advance revolutionized spectroscopy. The gratings now made with the Rowland engine have a resolving power of about 400,000, and the 10-inch Michelson grating, 600,000. These recent improvements in the ruling of the grating, with the added aid of photography, are extending far the limits of a fertile field of research and amassing valuable data for the ultimate demonstration of atomic structure. The time taken through a long number of years to construct an accurate screw was most profitably spent. The same amount of time employed in the taking of observations, in

making hypotheses, or in formulating generalizations, could not have produced results of like significance. It is to be hoped that the probable limit attainable by the present method of construction may be reached, and that we may soon have a 20-inch grating with a resolving power of more than a million.

A technique for making metallic replicas of gratings is highly desirable and should be attempted. The few good gratings that can be obtained only after years of painstaking preparation should be indefinitely reproduced.

Turning for a moment to the subject of temperature, we find that the first thermometer was devised by Galileo and consisted of a glass bulb with an attached tube whose end dipped into water. It measured temperature changes with an accuracy far greater than our heat sense could estimate it, and was truly a wonderful instrument. It made the sense of sight serve the function of the heat sense, and did it better. The original instrument was affected by changes of atmospheric pressure and had an arbitrary scale. These defects were gradually overcome. The bulb was filled with water and the tube sealed. The present fixed points, after many others had been tried, were finally adopted. Mercury was selected as the most suitable liquid for general purposes. The material of the bulb has received due attention, and many modifications of the thermometer for various purposes have been devised. It is doubtless the most common scientific instrument in use. The development of the mercury thermometer has made itself felt in every line of research.

Other means for measuring temperature have been devised. Resistance thermometers, thermocouples, bolometers, and a variety of radiation pyrometers, have made possible investigations beyond the reach of the mercury thermometer.

The development of the nitrogen thermometer and of the thermodynamic scale has placed temperature measurements on a still more scientific basis. The thermodynamic scale has quite recently been extended to 1,550° Centigrade; and all measurements beyond that are still extrapolations based on the law of the thermocouple up to the melting point of platinum (1,775° C.), and on the two laws of radiation for higher temperatures.

The range of temperatures at our control for the study of natural phenomena extends from about two degrees Centigrade above absolute zero to 4,000 degrees, the outer limits being attainable through the invention of the liquid air machine and the electric arc. The oxidation of all materials at high temperatures has made the use of the electric arc impossible for most purposes. A recently devised furnace has overcome this difficulty, enabling experiments to be made in any gaseous atmosphere up to 1,600 degrees Centigrade; and also produces any temperature nearly up to that of the electric arc. The bombardment by cathode rays gives promise of the development of extremely high temperatures for experimental work in a vacuum. The attainment of the lower limit of temperatures has made possible the most wonderful discovery of "superconductivity," which, with the investigations on conductivity at high temperatures, adds most significant data toward the development of the theory of electric conduction.

The bellows, the siphon, the water pump, the fact that water is supported in a filled inverted bottle when its mouth is in water, and various other phenomena, were explained on the principle that "nature abhors a vacuum." The invention of the barometer by Torricelli (1643) almost

immediately enabled Pascal (1647) to prove the falsity of this principle and to establish the correct foundation for the theory of hydrostatics.

The invention of the air pump made possible a whole series of investigations. Recently we have been impressed with the invention of several forms of pumps which enable us to obtain very high vacua with great ease and rapidity. The importance of such appliances must not be overlooked. Time is a most important asset for the investigator.

I wonder whether we appreciate what we owe to the great accessibility and continual improvement in manufactured materials. What a luxury we have in insulated wire! How could we do without glass tubing! We recall with what difficulty Pascal procured a tube for repeating Torricelli's experiment. Now we have even quartz tubing and quartz vessels of all kinds. The recent discovery of producing tungsten in a ductile form has made that element indispensable for some purposes. Fibrox, a new material not yet purchasable, is an improvement on all heat insulators. Manganin wire, with its application to all kinds of electrical instruments, has made electrical measurements of high precision comparatively simple. But it is not necessary to enumerate further.

Turning now to electricity for our examples, we find that the electroscope has developed from the pith balls and the simple gold leaves into a variety of very sensitive instruments, and the Thomson quadrant electrometer, into that of Dolezalek. The string electrometer makes it possible, for the first time, to measure rapid changes of a charge.

One of the great conveniences of a modern laboratory arises from the high state of perfection of current-measuring instruments. Galvanometers which are already highly developed are still continually being improved. In the moving coil galvanometer higher sensitivity is being attained, and efforts are being directed specially to obtaining a greater constancy in the zero reading and a greater uniformity of the radial field. The development of the galvanometer and of the methods of its standardization are of extreme importance to research.

The electric condenser, which was first made without regard to absorption, has gone through the stage where it was considered an improvement to saturate the dielectric with moisture, then where, in the process of construction, the condenser was boiled in a vacuum; to the present method of boiling at the highest possible temperature, and then subjecting to high pressure. Many problems in the development of the condenser still remain to be solved. The better elimination of the absorbed charge would add greatly to its use as a precision standard for the measurement of the electric quantity, and would be of great importance wherever condensers are employed with alternating currents.

The recent developments for excluding moisture from resistance coils, and for rendering them free from capacity and self inductance, show that advancement even in the construction of resistance standards is still in progress.

The Crookes' tube has resulted in the discovery of the X-rays, which are now proving of such great service not only in medicine, but in the study of atomic structure and of atomic distributions in crystals.

The human voice was first transmitted by electricity in 1876. The rapid conquest, since that time, of the almost insurmountable obstacles of long-distance telephony has been due to progress in many lines of research and to the large number of workers striving for the same end. The present

transcontinental telephone line is 3,400 miles in length and transmits speech without distortion. The chief factors that have contributed to this result are the Bell receiver, the microphone, the coils for preventing voice distortion, and finally the invention of the thermionic amplifier.

The twenty-fifth day of January of this year marks the beginning of transcontinental telephony by wire and September 29 that of transcontinental telephony without wires, both great achievements having been accomplished in our own country and since our last annual meeting.

The experimental proof that the condenser discharge is oscillatory and Maxwell's (1831–1879) theory of electromagnetic waves led Hertz (1857–1894) to devise the apparatus which demonstrated the existence of such waves. The value of these purely scientific efforts is seen in the result. It was found that connecting one end of the vibrating system to the earth and the employment of long antennæ improved the sending power of the transmitter; and the development of detectors improved the receiving apparatus. We have then, as applications, the wireless telegraph which is rendering such unusual service; and finally, with the development of the thermionic amplifier, already mentioned, the wireless telephone which has so recently enabled the human voice to travel across our continent and beyond to Honolulu, a distance of 4,850 miles.

A modest-looking little bulb containing a stream of almost inertialess particles known as the thermionic current would hardly have been suspected of being able to bring about, as it has, so important a step in the development of long-distance telephony of both kinds. By means of this little instrument, or rather many of them, the energy of the original telephonic current can be increased many billion times, which is then transformed, in part, into ether tremors and sent in all directions across oceans and continents and there transformed again, reproducing the original speech without distortion. Our sense of appreciation seems to have been hardened by many and great successes. We seem to be stunned, unable to comprehend fully the significance and the greatness of such a marvelous achievement.

Apparatus has been devised for the counting of both the alpha and the beta particles, and the existence of atoms has been demonstrated beyond question. The simplicity of the apparatus devised by C. T. R. Wilson for making visible the paths of the alpha and the beta particles, atoms and the minute pieces of atoms, makes us wonder whether anything is impossible, providing we have the genius to devise the proper instruments.

Radioactive substances would be exploding with stupendous violence, and their quivering atoms be sending ether pulses into space, a whole world of great activity about us, and we should be in complete ignorance of it, were it not for the electroscope and the photographic plate.

As was intimated at the beginning, this partial summary has been presented mainly for the purpose of illustrating the extent to which the development of instruments has been a contributing factor in scientific progress. It is to be noted that in many cases advancement can proceed to a certain point and then must necessarily stop, no further significant progress being possible until some required instrument of research is perfected or an entirely new one devised. It is often more profitable to devote time to developing instruments than to the continuing of investigations whose results become obsolete as soon as the instruments employed are improved. The painstaking observations of Ångström, notwith-

standing their great value, were discarded as soon as better gratings were produced.

The simplest of instruments have often been the means of making great discoveries. Faraday and Henry worked with the most simple tools. Many discoveries as far reaching as any will again be made with the simplest apparatus; but advancement in other directions can only be effected after the highest possible development of instruments and processes.

Some men by devising what appeared to be a little improvement in a machine have indirectly advanced science more than would many painstaking investigations. Instruments like the Crookes' tube lead to the discovery of facts that were entirely unsuspected and unsought; and similarly many instruments have been developed for one purpose and then found to be of value in an entirely different field. We have seen many problems solved which at first appeared beyond the possibility of demonstration or accomplishment. There seemed no possible method of approach. There were no instruments with which the results could be attained. Photography, wireless telephony, counting atoms, and seeing the tracks of atoms and of fragments of atoms, are some of the accomplishments which not so many years ago would have been considered beyond the range of possibility.

Many instruments are used as tools to perform certain definite functions in a more complex system, and, as such, should be so constructed as to require the least possible attention. As far as it is practicable the instrument should read directly the quantity desired. We already have many such instruments, as, for example, the ammeter, voltmeter, fluxmeter, potentiometer, Wheatstone bridge, direct reading spectrometer, and the recently devised instruments for giving directly the length of electromagnetic waves and their logarithmic decrement. The "artificial eye," also recently devised, gives in the photometry of colors results equivalent to that of an average eye, eliminating the necessity of several observers. In the measurement of conductivity an apparatus has been so assembled as to give directly the resistance in microhms per cubic centimeter. Self-recording instruments of all kinds are a great convenience and in many operations practically indispensable.

The intricacy and difficulty of many operations which often retard progress should be removed as far as possible. Every instrument improved to give greater convenience and greater simplicity in operation, makes it possible for all who use it to concentrate their whole energy on that part of their work which has real significance. This adds much to efficiency and productivity in science.

I wish to emphasize the importance of using the best and most convenient instruments obtainable for any given purpose. We may learn from manufacturing establishments the advantage of discarding apparatus that has become obsolete or not suited for our particular purpose. In no other way can our output become what it should be.

There are many problems pressing for solution, and every unexplained phenomenon may hold in store still more problems or strange relationships and unknown entities. Most of the solutions can be made only with the aid of scientific instruments.

We want to know something definite about the nature of gravitation and of the ether. We want to understand more completely the structure of atoms and molecules. We want to know the structure of corpuscles and nuclei. We want to understand the interatomic and intermolecular forces. We want to know what determines

the various properties of the different elements. We want to understand the nature of positive and negative charges of electricity. We want to know the nature of electric and magnetic fields and the relation between the two. We want to know a great deal more about the mechanism of radiation.

We must find a way of obtaining power from coal more economically. The direct energy of the sun should be employed and stored for use at night and in winter. The energy of the tides and of the wind must be economically utilized. These and a thousand other problems are waiting for solution.

The ultimate aim of science, as I see it, is to solve the mysteries of nature not only for the purpose of broadening our vision of the external world and for making its forces serve our physical needs, but also in so doing to help guide us to a fuller understanding of our relation to the universe and of the miracle of our existence. May we not ultimately learn something definite about the relation of mind and matter?

We must place no limits to the possibilities of science. Speculation and the imagery of what may lie beyond the present boundaries of knowledge are an incentive to greater effort, and are of real value when given their proper place.

I have called attention to the importance of instruments in scientific progress. I have emphasized the importance of perfecting the instruments, not only with regard to greater precision but also with regard to convenience in operation, so as to enable new ideas to be subjected to experiment with the least possible effort.

The vastness of our field and the interdependence of the different branches make it impossible for any one individual or a small group of individuals to be familiar with all the known processes and instruments for accomplishing definite ends. Our investigations often lead to the determination of some quantity we are not accustomed to measure, and we wish to know at once what is the most practical apparatus to employ. Much time is often wasted in devising an instrument that has already been developed, and inefficient devices are often finally employed unnecessarily. When we consider the large number of investigators concerned and the importance of the work, this is a serious matter. We may obtain help from the catalogs of manufacturers, we may write to some one who is more familiar with such measurements, we may search in various scientific books and magazines, technical handbooks, and reports of the bureaus of standards. Such procedure, however, is wasteful and uncertain, and as has already been stated, often leads to the employment of inferior and more cumbersome methods than is necessary. It is like searching for the meaning of a word from its use in literature, in place of using a dictionary, or like searching for physical constants in the original publications, in place of using compiled tables. It is like these, except that it is much worse. Most instruments and methods are described under the titles of the investigations in which they were first employed, which, in addition, are often published in inaccessible journals.

We need what we may call an *encyclopedia of instruments and methods of research.* This should include materials, methods and processes, as well as individual instruments employed in research in all the sciences. Progress in the development of apparatus is so rapid that it would be necessary to issue a yearly supplement and probably to publish a revised edition every few years. This could be done by some bureau or organization with the cooperation of all scientific men. In the simplest form it could give the apparatus and the different methods for accomplishing each definite purpose, a short statement concerning each instrument, with references to

journals where it is fully described, and all improvements to date. If it was desired to produce a low vacuum, all the known methods and the limitations of each would be at once found in such an encyclopedia. If one wished to measure low pressures, the encyclopedia would call his attention, with references, not only to the McLeod gauge but also to the recently devised molecular gauge which might give more accurate results in those particular measurements. If one wished to maintain a constant temperature at several successive points from the temperature of solid carbonic acid to that of liquid air, he might spend a long time in devising an apparatus, but the encyclopedia would at once refer him to the methods that have been successfully employed. Such a publication would add much to efficiency, and the cost would be small compared to the great service rendered to science.

We also need a *journal of scientific instruments*, in English, devoted entirely to the description of new methods and instruments.

I have often felt the need of both such publications, and I am sure that much energy now wasted would be conserved, and on the whole more worthy contributions to science produced. When once accustomed to such necessities we should wonder how we managed to do without them.

We are entrusted with the responsibility of solving some of the greatest and grandest problems confronting the race. It is our plain duty to be improving conditions for individual and general efficiency. We must point out the needs of science in definite and concrete terms, and must not hesitate to urge upon society that it supply all real physical needs for the proper prosecution of its scientific work.

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## PSYCHOLOGICAL AND HISTORICAL INTERPRETATIONS FOR CULTURE[1]

THE mere fact that we have in Section H a joint segregation of anthropology and psychology would seem to imply some close functional relation between these sciences. However, the most probable explanation of the phenomenon is to be found in the distinctly anthropological conception of historical association. If one may be pardoned the diversion, I would say that most likely this association is due to the shrewdness of some one in finding a chance to smuggle psychology into the scientific camp. Yet, if one recalls the various annual programs of the section, there comes to mind a considerable number of papers and addresses professing to authoritatively interpret cultural phenomena by the aid of psychological conceptions. So far as I know, the authors of these papers have all been psychologists, rarely has an anthropologist ventured to set the psychologists right. Many of these psychological discussions of anthropological problems have struck the anthropologists as a bit naïve and I have not the least doubt but that for once, the psychologists will in turn get a naïve reaction, because I propose to present reasons for doubting the validity of such psychological explanations for cultural phenomena.

We have a considerable bibliography under the heads of psychology of religion, psychology of art, psychology of sex, and psychology of society. Of these the professional psychologists have the first two almost entirely to themselves, but share the others with the sociologists. In the development of their subjects, the psychologists

[1] Address of the vice-president and chairman of Section H, Anthropology and Psychology, American Association for the Advancement of Science, Columbus meeting, December, 1915.

have as their fundamental assumption the belief that religious phenomena are susceptible to statement in psychological terms and that their ultimate explanation is to be sought in conventional psychological principles. By analysis, they seem to seek for a psychological mechanism, or a fixed association of activities, that is responsible for the appearance of religion on the earth and its subsequent development. One of their initial assumptions is that by this mechanism, or whatsoever they prefer to call it, man has gradually built up the religion of the world to-day. They take for granted that the religions of the less civilized peoples of our time are examples of the earlier forms of this development, and seek in them the fundamentals of religious evolution. The chief aim is to show how the religious activities of our people can be explained as normally evolved from the functioning of this assumed mechanism. It follows that one of these psychological authors would consider his task brought to a glorious end if he could formulate a statement of the gradual building up of religion that was entirely consistent with the data at hand; and would consider that he had revealed the cause of its appearance to lie in a definite mode of action in man's nervous system.

Though we have so far spoken in terms of religion, the general assumptions in the treatment of art, sex, etc., appear to be the same. All these psychological investigators are striving to bring the phenomena of culture entirely within the conventional limits of psychology and to explain it by psychological principles.

In order to bring out clearly the differences between this attitude and that now assumed by our representative anthropologists, we may try to apply the same mode of characterization to their works. I do not recall any serious recent attempt on the part of an anthropologist to discuss the anthropology of religion as a whole or to examine our own religion by anthropological tools, but if the attempt were to be made, the preconceptions would be about as follows. In a treatise on our religion, the phenomenon would be considered adequately explained by identifying it with culture. Culture origins would be sought in a comparative analysis of our religion and in tracing out the sources from which the various elements in the complex came. The ideal would be to state where, among whom and under what conditions, these several elements arose and were associated in the present complex, the whole constituting what may be considered as a historical explanation. It is not conceived that the carrying of this analysis to its ultimate extreme would give us a statement of religion as a world phenomenon, for the religions of other peoples have different histories, and though we see on every hand indisputable evidences of mutual borrowing and interaction, the fundamental elements of the world's religions have decided individuality. Hence, if we confined our efforts to tracing out the historical development of only such elements as are found in our own religion, we should ignore a considerable part of the phenomenon at large. Therefore, a general treatise on the anthropology of religion would begin with the exhaustive study of a number of religions and finally seek by a comparative view, a generalized statement of the historical relations between the religions of the world. Thus could be constructed a theoretical outline of the development of religion as we now find it among the several peoples of the earth. On practically the same lines we should expect to develop the anthropology of art, literature, music, marriage, social organization, etc.

Now if these are true characterizations

of the two methods, it is clear they have important differences. Both use the same data as to the kinds of religious activities in the world, but the psychologists seek their origin in universal psychic activities, while the anthropologist is content to find the approximate localities and relative times whence the various elements come into view. Though perhaps not at first apparent there is nevertheless a fundamental difference between the two, which it is my purpose to develop in this discussion.

Like psychology, anthropology has been rapidly developing its problems and conceptions, and is just emerging from its formative period. Its position and scope is perhaps as clearly formulated now as is that of psychology. In the main, it deals with culture and the various problems directly related thereto. Anthropology is perhaps most correctly defined as dealing with the first appearance and subsequent career of man upon the earth. While comparative morphology in all its human aspects is an important method, it is based upon and dependent upon other sciences and has for its ultimate goal the elucidation of historical cultural relationships. Culture is the distinctly human trait and must always be appealed to to determine the status of such fossils as the *Pithecanthropus erectus*.

Cultural phenomena are conceived of as including all the activities of man acquired by learning. Thus we eliminate, on the one hand, the permanent individualities of the separate men and, on the other, whatever equipments they may have had by birth. Cultural phenomena may, therefore, be defined as the acquired activity complexes of human groups.

It follows, then, that there is a problem of almost equal concern to psychologists and anthropologists—the differentiation between the innate and the acquired. Psychologists give their attention to innate phenomena, especially man's psycho-physical equipment. If we extend the meaning of the term behavior so as to include consciousness, we may say that psychologists are concerned with the behavior of man as an individual. If one may trust to the remarks heard, psychologists are quite given to the assumption that anthropologists are simply students of comparative human behavior. At least psychological literature contains more than one example of the behavioristic interpretation of cultural data. Now, it may be that there is a problem in the comparative behavior of the individuals comprising ethnic groups, but, if so, it is a psychological one and must be solved by the use of psychological data. Anthropologists give it little concern because they see in differences of individual behavior no significant cultural correlates. So far as they can see, all the known culture phenomena since the dawn of the paleolithic period necessitate no changes in man's innate equipment nor in his innate behavior. So, on the whole, anthropology is quite indifferent to the problems of comparative behavior, because it is concerned with the objective aspects of what is learned in life.

There is, however, one problem that troubles the anthropologists, viz., to distinguish between the innate and the acquired elements of the more fundamental activity complexes. One of the pressing anthropological problems of the hour is the effectiveness or non-effectiveness of instinctive factors in the differentiation of cultures. The problem is almost identical with the educational problem of inborn *versus* learned activities. The only systematic discussion of this problem is Thorndike's "Original Nature of Man," which, while projected from an educational horizon, is, nevertheless, a distinct contribution to the anthropological problem. One of

this author's illustrations may be cited as an example of the anthropological problem: thus we are told "that a child instinctively conveys food to his mouth with the naked hand, but by habit comes to use a spoon" (p. 3). Here it is clear that the use of the spoon in eating is a cultural fact in contrast to the use of the hand. As such, it falls into the same class with forks, saws, rifles, automobiles, etc., or into the general class of tools. A little reflection or a visit to an anthropological museum will show how completely tools dominate the objective phenomena of culture. Yet, our problem is far from simple. For example, what shall be said when the baby grasps the spoon and pounds upon the table with every manifestation of joy? Is pounding a phenomenon of culture or is it a part of original nature? The anthropologist very much needs to know where the distinction falls. He has at various times given it serious consideration, but finds no way to approach it save by logical analysis, resulting in the formation of an opinion. It seems that psychologists have done no better. Thorndike, for example, is delightfully frank in stating that in most cases as yet he is able to do little more than formulate an opinion. His general statement seems to be that while original nature often decides that an individual will respond to certain situations, it far less often imposes upon him a definite response or limits the time of such response. To this, as a generality, anthropologists will agree: it is in fact another way of stating their own opinions. To them its formulation would be something like this: while all culture is acquired, there must still be a complex of instincts to acquire and participate in cultural activities; but only very rarely, if at all, specific instincts for the acquisition of a particular culture. While such generalities are of great value, serving to clear the air as it were, they unfortunately solve no problems nor relieve us of the necessity for real concrete investigation.

Reverting again to the tool-using complex, the anthropologist is quite ready to assume that to seize any convenient object and use it to assist movement is instinctive; and more, that the tendency to observe the specific use of tools by others and self-learn the use of the same, is in its fundamental aspects instinctive. Finally, there is a presumption that there is some instinctive factor in the invention complex, that leads to the production or modification of culture traits. That there must underlie the development of cultures an instinctive complex tending to culture production seems a necessary assumption to those familiar with anthropological data.

One general point about which psychologists seem to agree is that the associations of ideas are not innate. This is expressed by Thorndike (24) as follows:

> It is unlikely that the original [innate] connections are ever between an *idea* and either another idea or a movement. No one has, I think, found satisfactory evidence that, apart from training, an idea leads of inner necessity to any one response. And there is good evidence to show that original connections are exclusively with sensory situations. . . . We have, of course, by original nature the capacities to connect the idea of one thing to the idea of another thing when the two have been in certain relations, and to break up the idea of a total fact into ideas of its elements, when once ideas have been given that are capable of such association and analysis. But we do not apparently, by original nature, have preformed bonds leading from ideas to anything. If an idea apart from training provokes a response, it does so by virtue of its likeness to some sensory perception or emotion. Nor do we apparently by original nature respond to a situation by any one idea rather than another. *That* we think is due to original capacity to associate and analyze, but *what* we think is due to the environmental conditions under which these capacities work.

The *what* we think is largely determined

by our culture, for, so far as anthropologists can see, a culture is a definite association complex of ideas. When anthropologists assert that culture is not innate, they have this in mind and should, if it were true that definite associations between ideas were innate, find it difficult to harmonize these contradictions. The assumption, therefore, that it is chiefly between sensory factors that inborn connections exist, is complementary to the anthropological view. In content, culture is highly rationalistic, or fundamentally a matter of thought, or idea connection. There is, however, considerable confusion on this point, apparently due to lack of discrimination as to the thinking process and what is thought. As we have already noted, the individual's attitude toward culture is apparently entirely an innate affair, or is truly a part of his innate behavior. The obscurity of the case arises in part from the fact that it is this innate behavior that produces cultures and perpetuates them. It is quite natural, therefore, that many should claim the non-rationalistic factors as cultural. We have various fairly satisfactory theories of culture origin based upon the conception that man's less material traits are rationalistic constructs from instinctive actions, the latter serving as the suggestive structural elements. Our contention here is, however, not on the reality of an instinctive basis to culture, but that the investigation of man's true behavior is a psychological problem and must be approached from the psychological horizon. The moment we, as anthropologists, attempt to apply cultural data and cultural methods to these underlying instinctive phenomena, our psychological friends will find our assertions just as naïve as theirs to us when they reverse the application. Since we can not expect to be at home in the psychological field, we must leave those problems to them.

Perhaps in passing we should note the much-discussed question as to the power of ideas, for many psychologists vigorously insist that an idea can in some way lead to action irrespective of other conditions. Now it may be that every idea causes a reaction, as to that an anthropologist's opinions are of no importance, but such acts seem to fall into the behavior class and belong, therefore, to the innate equipment of man for cultural activity.

We are familiar with the fact that all the known cultures of the world have certain marked similarities; in fact, from one point of view, they are very much alike. It has been claimed that this likeness is due to many fundamental ideas in common. Bastian seems to have believed that these ideas were to be found wherever people lived, because the very constitution of their nervous system made them arise with certainty. Now, if this is true, such ideas must be set down as part of man's original nature. If they result as a universal response to situations, the situations must be uniform; but in any event, if all men, however isolated from birth, will get these ideas, then they are essentially inborn and so constitute the basic elements of culture.

We may also note the older belief that man's original nature was so ordered that social groups everywhere tended to develop their culture on the same pattern, rising from the lowest state of savagery to the highest civilization. This again, if true, would necessitate a kind of mechanical view, for we make the whole merely a response on the part of man's original nature.

However, these views are quite antiquated. We now have the rival theories of independent development and single origin of culture traits. In response to the independent versus common origin of traits, we have such compromise theories as convergent evolution, limited possibilities, etc.

The problem confronting these theories is to identify the causes underlying the observed similarities of culture traits.

It is clear that the theory of a single origin for even the most widely distributed traits assumes no necessity for the inheritance of particular ideas. The theory of independent origin when invoked to explain the occurrence of certain traits in large distinct areas as in both the Old and New World, is also consistent with the unoriginal nature view; but when pushed farther and made to account for the separate appearance of a trait in many places, leads its supporters into an embarrassing position. When we assume a single place of origin for a trait, we take the view that its appearance is accidental. Thus, original nature offers no explanation for the event, only a historical account of what transpired in the place and time will suffice. For example, some anthropologists are of the opinion that the bow was invented but once and thence found its way gradually over the world by diffusion. (This seems likely in view of the known history of firearms.) In such cases, it appears that the invention and its development in one place is due to the chance combination of many causes. Underlying it is an idea whose occurrence in the mind of an individual was truly accidental. I have elsewhere referred to this view as the psychic accident theory for culture origin. Now the difficulty in extending the independent origin theory to many small areas is that we have too many accidents, unless one can show that the possibilities are limited to a few alternatives and that all men will be made aware of the same kind of situation. However, few anthropologists take the extreme view that all occurrences of the same trait are due to independent invention, the general tendency being, when a trait has a continuous distribution over an area, to consider it as having been diffused from one point or center included in, or contiguous to, the area in which it is found. Thus, that the bow may have been invented in two or three parts of the world is conceivable without doing violence to our experience with chance phenomena; but, if we go on and divide up the world into small units we soon reach a point where we must find other than accidental causes. The defenders of the independent theory recognize this, for practically all resort to the assumed unity of the human mind to account for the frequency of widely distributed traits; but when they do so they put themselves into a position where the denial of direct dependence upon original nature is next to the impossible.

In general, if we take cognizance of psychological knowledge, it appears that so far all attempts to explain particular culture traits as due to the unity of the human mind have been abortive. On the one hand, we have no psychological evidence that particular ideas are due to particular psycho-physical biases—in fact there is abundant evidence to the contrary—while on the other, we have the obvious fact that cultures do differ and that one of these common culture traits when displaced soon passes into oblivion or does not recur. For example, how many of us would ever have conceived a bow, if the thing were not taught us? Further, the unity of the mind theory ignores the great unity of the physical world which certainly controls many traits of culture. Thus, the problem of cutting has but one ready solution a material harder than that to be cut and a knife edge. This is due to the physical unity of the world. Hence, whenever men happen to solve this problem, their solutions tend to similarity in the essentials of cutting tools; but if the unity of man's mind predetermined the solution, why should we

have such a variety of cutting tools as we find in our museums? The unity of mind seems to be an expression for uniform behavior and applies to the original nature of man. To explain facts of culture by asserting the unity of the human species, is little more than the useless pleasantry that culture exists only because there are men in the world. But one may retort that a psychology of religion, or what not, seeks to discover precisely why these ideas arose or were so associated. Our contention is that this can be done only by knowing the history of the case and that this history can not be reconstructed from an ensemble of culture traits, however minutely they may be described in psychological terms.

In the various aspects of the tool traits of culture we have one of the most important series of data bearing upon both the psychological and the anthropological problems of culture origin. It is perhaps less fundamental than language, but is objectively superior because of the indestructible nature of many types of tools. For example, we find in the cave deposits of western Europe, some of man's first stone tools. We have previously noted the probably instinctive basis for tools. Thus, it may be granted that man is by original nature a tool-using and tool-wanting animal. Yet it is difficult to determine if he is a tool-maker by original nature, for the tool-making complex appears as only the mechanical adaptation of natural forms in which materials are found. It has been shown by anthropologists that many forms of stone tools are but slight modifications of selected pebbles, whose natural shapes were adapted to the specific purpose for which tools were sought. The same general principle holds for all tools, for the maker has to adapt his methods to the mechanical properties of the original materials from which the tools were to be made. This adaptation is surely the rationalization of experiences arising from original responses to tool-using situations. This invention, or the production of new traits of culture, may itself be rationalized, as is the case when we deliberately set ourselves an inventive task, or even when we recognize the inventive process as a method of culture production. All this must be granted, but there are innumerable times when new conceptions come as the normal undirected activity of thought. So it seems that rationalization must as a process be original or a part of man's original nature. We see that culture production, as the devising of tools, etc., is a product of the rationalizing capacity of man, which in turn is a part of his original nature. Therefore, there is good reason for assuming an underlying innate basis for tool-making in particular and culture production in general.

This clears the way to a fundamental problem: viz., the origin of culture. If culture is a matter of ideas, or the functioning of the rationalizing mechanism, then the first prerequisite to the observed condition is the appearance of an anthropoid with this element in his original nature. The forms and varieties of cultural remains seem to necessitate from the first the existence of this rationalizing power at its present level. Thus, it may be objected that the forms of stone tools found in the oldest cave deposits were produced by instinct alone, just as the spider spins a web or the bee fashions a comb. The answer to this lies in our museum collections where we find considerable variety in form in a given deposit, but particularly in the many sudden and abrupt changes as we pass from one stratum to another. Then again, Australian natives were but recently observed making forms identical with some of paleolithic origin and with them the instinctive explanation would be absurd. Their

method of learning the art and their mechanical attitude toward it is as rationalistic as similar homely arts are with us. In brief, we fail to discover any essential differences in the tools of early man and those now made in a rationalistic manner; hence we can do no more than assume that from the first they were mere inventions. There may be, however, very great differences in the intensity of rationalization between our ancestors and ourselves, but it is difficult to see how even the earlier cultures we know could have taken form without the same qualitative rationalizing power. Further, one of the questions anthropologists would like to hear discussed is as to whether the assumed greater intensity of modern rationalization is not merely apparent, only the accumulated momentum or the complex of short-cuts our culture has developed. Anthropologically, it seems that the phenomenon is entirely one of accumulation and short-cuts; but this may be found incompatible with psychological and biological data.

Returning now to the question of a tool-using instinct as previously stated, it may be objected that this also is but a rationalization or invention, and so not innate. Now at least grasping in the hand is innate and so is the picking up of objects. Then since there is certainly an innate striking response, we have at least the necessary elements of instinctive activity. Though we are here dealing with a problem yet to be solved, my own observation seems to justify the assumption that to seize an object and pound with it rather than the hand, is an innate phenomenon even in very young children. As suggested above, anthropologists favor the view that no mechanical movement complexes for tool-making are innate, but that there is in man's original nature a mechanism that lays hold of things and thus supplies the basis for self-rationalization and for the acquisition of the great store of accumulated rationalizations of the race, or culture.

The point we are coming to is that the anthropological conception of culture is entirely consistent with the psychological view, for it asserts that neither mental bias nor biological attributes are of the least avail in explaining the origin of specific culture traits and that it is only when we know the history of a case that we can give anything like an adequate account of its origin. It is thus clear that when we are dealing with phenomena that belong to original nature we are quite right in using psychological and biological methods; but the moment we step over into culture phenomena we must recognize its historical nature. This is why anthropologists object to much that passes for the psychology of religion, art, etc., in which many of the results obtained by use of the historical method are put on a level with those obtained by other methods, and then interpreted as facts of evolutionary or other non-learned activities. To them such terms as psychology of religion, psychology of society, of law, of sexual restrictions, etc., are often so used as to be worse than meaningless for they at once assert what is contradictory to psychology itself.

We are now ready to consider the value of psychological explanations for culture origins. We often read that if culture phenomena can be reduced to terms of association of ideas, motor elements, etc., there remains but to apply psychological principles to it to reveal its causes. This is a vain hope. All the knowledge of the mechanism of association in the world will not tell us why any particular association is made by a particular individual, will not explain the invention of the bow, the origin of exogamy, or of any other trait of culture except in terms that are equally applicable

to all. What more can psychology tell us than that these inventions were thought out by somebody. So when a culture complex has been analyzed and found to rest upon the association of two or more ideas, we do not thereby raise a specific psychological problem at all. The problem we do raise is as to where and at what relative points in man's career did these ideas appear, and the solution is to be sought in the historical relations of the people among whom they originated and not in innate psychological characters.

Our purpose is not to deny the existence of a psychological problem in culture; far from it. We are only pointing out what aspects of the problem can consistently be subjected to psychological methods and calling formal attention to the very crude method of taking learned activities for innate ones and thereby explaining cultural phenomena. Psychology can be of the very greatest service to anthropology by discovering the relations between man's innate and cultural equipments.

CLARK WISSLER

THE AMERICAN MUSEUM
OF NATURAL HISTORY

## CHARLES RENÉ ZEILLER

LORRAINE has produced many men who have adorned the annals of the sciences, arts and politics of France. None are more worthy of honor than Professor Zeiller, the dean of paleobotanists, who passed away at his home in Paris on November 27.

Born at Nancy on January 14, 1847, he was educated at the École Polytechnique and École des Mines, so that naturally he was a member of the auxiliary corps of engineers during the Franco-Prussian war. His father was engineer-in-chief of bridges and highways of Lorraine and on the maternal side he was descended from the sculptor Guibal.

Although the illustrious mantle of Brongniart and Saporta has long rested on Zeiller's shoulders his earliest contributions were not paleobotanical, but metallurgical and geological, and published in the *Annales des Mines* in 1870 and again in 1871, both devoted to the Eifel region. In 1873 he published a memoir on the eruptive rocks and metalliferous veins of the Schemnitz district. His first paleobotanical contribution was an analysis of Schimper's great work, "Traité de Paléontologie végétale" and published in the *Revue scientifique* in the spring of 1874, thus indicating the trend of Zeiller's mind at that time and foreshadowing the field of endeavor to which he was to so successfully devote the mature years of a reasonably long but never robust life.

As an engineer of mines the fossil floras associated with the coal were the subject of his chief professional interest, although Zeiller was not a narrow specialist, but a contributor to all phases of paleobotanical activity. With a rare facility he was equally effective in describing the histology of *Sphenophyllum* and *Lepidostrobus* or the impressions of plants of the Paleozoic, Mesozoic or Cenozoic. The last paper from his hand that I have received was an account of the Wealden flora of Peru, and in his last letter, written just before the end, he asked me to send him a copy of Walcott's recent paper on Algonkian Algæ. It was this world-wide interest combined with a philosophical temperament that made the many annual reviews of the progress of paleobotany published in the *Annuaire universel de Géologie* and the *Revue bibliographique* of such lasting value.

Zeiller's first original contribution to paleobotany was an account of the flora of Ternera in Chili published in 1875, and the wide interest and facility of treatment are shown in a succession of works whose stratigraphic range is from the Devonian of Pas-de-Calais to the Tertiary of Tonkin-China, embracing discussions of floras of the Carboniferous, Permian, Triassic, Jurassic, Cretaceous and Tertiary. Outside his native land he contributed to the paleobotany of Spain, India, the Vosges, the Balkans, New Caledonia, Indo-China, Madagascar, Central and South Africa,

Brazil, Peru, Chili, Persia, Russia, Asia Minor (Heraclée) and China.

Professor Zeiller was one of the first to demonstrate the precision with which fossil plants can be used in stratigraphic geology and in the numerous large memoirs on the Carboniferous and Permian floras of the coal basins of Grand-Combe (1884), Valenciennes (1888), Commentry (1888–1891), Epinac (1890), Brive (1892), Blanzey and Creusot (1906), as well as in his work on the fossil plants, which forms part 2 of Vol. 4 of "Explication de la carte géologique de la France" (1879), he displayed a philosophic interpretation that had never been equalled. Since 1878 the mining engineers of France have had the benefit of his annual course in paleobotany at the École nationale des Mines, the excellence of which is attested by his "Éléments de Paleobotanique" published in 1900, which remains not only the best but the only well balanced text-book on this subject that has ever been written.

Professor Zeiller was not only a voluminous contributor to his chosen science, but a life-long teacher and a conscientious and efficient administrator, having been for more than twenty years the secretary of the National Board of Mines, Inspector General since 1884 and Vice-president since 1902. He had charge of the *Annales des Mines* from 1874 to 1910. For a period of forty-five years he was an honored member of the *Société géologique de France* and its president in 1893. Honors came to him freely both at home and abroad. He was a commander of the Legion of Honor and a member of the French Academy since 1901. Cambridge conferred its Sc.D. on him at the time of the Darwin Centennial.

Professor Zeiller was a sort of father-confessor to the younger paleobotanists of all races, and they found in him a wise and kindly critic, always painstaking and helpful, as well as a generous and inspiring friend. His rare ability was combined with an equally rare modesty that endeared him to a wide circle on this side of the Atlantic, and wherever fossil plants are studied his name will ever be honored. This is neither the time nor the place for a critical analysis of his contributions to science—our grief is too recent. That he upheld the high traditions of French paleontology there can be no doubt. His epitaph might well read *Nil nisi bonum.*

E. W. B.

## RECOMMENDATIONS OF THE PAN-AMERICAN SCIENTIFIC CONGRESS

The Second Pan-American Scientific Congress at its final session before adjourning to meet again at Lima in the year 1921, which will be the Peruvian centenary, adopted by unanimous vote thirty-six recommendations. Those relating to the sciences are as follows:

I. That it is highly desirable that the various American republics arrange for the appointment of delegates for joint action in the matter of archeological exploration, in order to formulate generally acceptable and substantially uniform laws relating to the survey, exploration, and study of archeological remains to be found in the several republics, and that laws shall be enacted which will effectively safeguard these remains from wanton destruction or exploitation and which will serve to aid and stimulate properly organized and accredited research in archeology.

II. That the government of the United States be requested to bring to the attention of the governments of the other republics participating in the congress and, through their respective governments, to the institutions and the public thereof, the importance of promoting research in the field of archeology, organized surveys for the study of primitive tribes, and the building of national educational museums for the preservation of the data and materials collected.

III. The American republics undertake as soon as possible: (*a*) Accurate, geodetic measurements which may serve to determine limits, national and international, and to contribute to the discovery of the true shape of our planet. (*b*) Magnetic measurements of their respective surfaces, and the establishment of several permanent magnetic observatories in which it may be possible to carry on during long periods of time observations concerning the secular variation of the magnetic characters of the earth. (*c*) To extend their gravimetric measures (obtained by means of the pendulum)

to those regions where these measurements may have not been taken, in order to obtain more information to determine the true shape of the surface and the distribution of the terrestrial mass.

IV. That the nations of the American continent establish, by means of their offices of geodesy or by committees appointed for that purpose, an international triangulation. That the governments of American nations reach an agreement for the purpose of creating an office or congress of cartography and geography.

V. That proper steps and measures be taken to bring about in the American republics participating in the congress a general use of the metric system of weights and measures, in the press, in educational and scientific work, in the industries, in commerce, in transportation, and in all the activities of the different governments.

VI. Confirms the resolution recommended to the American republics by the First Pan-American Scientific Congress regarding the installation of meteorological organizations to serve as a basis for the establishment of the Pan-American meteorological service, and expresses the desire that the republics not yet possessing organized meteorological service establish the same as soon as may be practicable.

VII. That there be appointed an international Pan-American committee to study and report upon the question of establishing such a uniform gauge as will best serve the countries' interest, their international communication, and the communication between all the countries of America.

VIII. The appointment of an American committee on radio communication to assist in development of the science and art of radio communication, to the end that it may serve to convey intelligence over long distances and between ships at sea more quickly and accurately, and to bring into closer contact all of the American republics.

IX. That through the governmental agencies of the American republics a cooperative study of forest conditions and forest utilization be undertaken and that the data thereon be published.

X. That each of the American nations appoint a commission to investigate and study in their respective countries the existing laws and regulations affecting: (*a*) The administrative practise of regulating the use of water; (*b*) The adjudicating of rights pertaining to the use of surface and underground water for irrigation purposes; (*c*) The distribution, application, and use of water upon arid and irrigable land; (*d*) Methods of conservation of surface and underground waters for irrigation or industrial purposes; (*e*) And to suggest laws or regulations in the interest of general industry, navigation and commerce.

XI. That the question of the reclamation of arid lands is one that should receive the immediate and careful consideration of the several governments of the American states, so that there may be increased areas of productive land to meet the needs of their increased populations.

XII. (*a*) That each country should maintain a well-organized and competent live-stock sanitary service comprising executive officers, field inspectors and a laboratory force; (*b*) That each country should enforce live-stock sanitary laws and regulations, with the view of preventing the exportation, importation and spread within the country of any infectious, contagious or communicable diseases by means of animals, animal products, ships, cars, forage, etc.; (*c*) That each country should maintain a thorough live-stock sanitary survey to determine what communicable diseases of animals are present and the localities where they exist. This information should be furnished regularly to each of the other countries at stated periods as a routine feature; (*d*) That each country should refrain from exporting animals, animal products, forage and similar materials which are capable of conveying infectious, contagious or communicable animal diseases to the receiving country; (*e*) That each country should enforce measures to prohibit the importation of animals, animal products, forage and other materials which may convey diseases from countries where dangerous communicable diseases such as rinderpest, foot-and-mouth diseases, and contagious pleuropneumonia exist, and which have no competent live-stock sanitary service. Animals, animal products, forage and similar materials from countries maintaining a competent live-stock sanitary service may be admitted under proper restrictions, regulations and inspections, imposed by the importing country; (*f*) That each country, through its live-stock sanitary service, should endeavor to establish a complete exchange of information as to the methods followed which have proved most successful in combating animal diseases; (*g*) That members of the live-stock sanitary service of each of the American countries should meet at regular intervals to consult and inform each other regarding the measures taken for furthering cooperation in protecting the live-stock industry of the American countries.

XIII. That an American plant-protection conference be convened, the delegates thereof to be one or more technical experts from each of the several American countries, and that, as soon as practicable, a meeting of this conference be held to discuss suitable legislation, the means of establishing competent scientific bureaus, and to recommend such cooperative research work and control of plant introduction as may be advisable, and to use all reasonable efforts to secure appropriate action by the several countries.

XIV. Recommends the distribution of information regarding the agricultural production of the different countries and of the publications relating thereto.

XXVIII. (1) That a compilation according to a definite plan be made of the mining laws of the American countries, not only in their original languages, but also in English or Spanish or Portuguese translations, as the case may be, with a view to the reciprocal improvement of the laws of each individual country. (2) That the several American governments appoint a committee to consider the uniformity of mining statistics, and to make recommendations to their respective governments for the systematizing, simplifying and standardizing of such statistics.

XXIX. That all American countries inaugurate a well-considered plan of malaria eradication and control based upon the recognition of the principles that the disease is preventable to a much larger degree than has thus far been achieved, and that the education of the public in the elementary facts of malaria is of the first order of importance to the countries concerned.

XXX. That the American republics in which yellow fever prevails, or is suspected of prevailing, are urged to enact such laws for the eradication of yellow fever as will best accomplish that result. That inasmuch as yellow fever exists in some of the European colonies in America, it is desirable to invite them to adopt measures for its elimination.

XXXIV. That the American governments, deriving important revenues from the consumption of alcohol, should organize their systems of taxation so that the economic interests be subordinated to the higher interests of a social and moral order, which tend to the suppression of alcoholism.

XXXV. That it is very advisable that the different monetary systems of the American republics be studied from a scientific point of view and in connection with the experience of the various American countries, in such matters.

XXXVI. That the American republics make uniform, as far as possible, the basis and adopt a common time for the taking of census, and adopt uniform principles in commercial and demographic statistics.

In conclusion, the congress specially recommends, for execution by the present Pan-American Union or by means of any other institution in actual existence or to be established, the following propositions:

The establishment of an intellectual Pan-American union to unite the various associations of different character—technical, medical, legal, etc.—divided into sections according to the groups that may be deemed convenient, such as a university section, a library section, etc.

The details thereof are contained in the records of the congress in the form of four propositions dealing with the proposed union. The organization that may take charge of its establishment will lay broad and deep the true foundations of intellectual Pan-Americanism.

## SCIENTIFIC NOTES AND NEWS

The permanent secretary of the American Association for the Advancement of Science requests us to state that in the report of the Columbus meeting reference should have been made in the account of the opening exercises to the admirable response to the address of welcome by the president of the association, Dr. W. W. Campbell, director of the Lick Observatory.

The Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Dr. George Ellery Hale, director of the Mount Wilson Solar Observatory.

At the recent meeting of the American Society for Experimental Pathology in Boston, Dr. Simon Flexner was elected president, Dr. Gideon Wells vice-president, and Dr. Peyton Rous secretary for the year 1916. The Society for Experimental Pathology will hold its next meeting in New York next December, together with the other constituent organizations of the Federation of American Societies for Experimental Biology. Dr. Flexner is the chairman of the executive committee of this organization for 1916 and Dr. Rous is general secretary.

Officers of the Philosophical Society of Washington elected for 1916 are: *President,*

L. J. Briggs; *Vice-presidents,* E. Buckingham, G. K. Burgess, W. J. Humphreys, Wm. Bowie; *Secretaries,* J. A. Fleming, P. G. Agnew; *Treasurer,* R. B. Sosman; *General Committee:* The foregoing officers and the following members-at-large: H. L. Curtis, N. E. Dorsey, R. L. Faris, E. G. Fischer, D. L. Hazard, R. A. Harris, W. F. G. Swan, W. P. White, F. E. Wright and Past-presidents G. W. Littlehales and C. K. Weed.

RECENT grants from the Bache Fund of the National Academy of Sciences have been made by the Committee as follows:

No. 187 to H. H. Lane, State University of Oklahoma, $500 for the purchase of apparatus to be used in a comparative study of the embryos and young of various mammals in order to determine, by physiological experimentation and morphological observations, the correlation between structure and function in the development of the special senses.

No. 188 to H. W. Norris, Grinnell College, $100 for assistance in the analysis of the cranial nerves of Cœcilians (*Herpele* and *Dermophis*).

No. 189 to E. J. Werber, Woods Hole, $230 for assistance in experimental studies aiming at the control of defective and monstrous development: (1) The effect of toxic products of metabolism on the developing teleost egg; (2) the effect of experimentally produced diseases of parental metabolism on the offspring in mammals.

No. 190 to H. S. Jennings, Johns Hopkins University, $200 for assistance in the study of evolution in a unicellular animal multiplying by fission: heredity, variation, racial differentiation in *Difflugia.*

No. 191 to P. W. Bridgman, Harvard University, $500 for mechanical assistance in an investigation of various effects of high hydrostatic pressure, in particular the effect of pressure on electrical resistance of metals (continuation).

No. 192 to J. P. Iddings, Washington, D. C., $1,000 for apparatus and assistance in the microscopical and chemical investigation of igneous rocks, for the purpose of extending knowledge regarding petrographical provinces and their bearing on the problem of isostasy.

No. 193 to C. A. Kofoid, University of California, $500 for assistance in securing animals in the Indian jungle and in their preparation for study in research on the intestinal protozoa.

No. 194 to R. A. Daly, Harvard University, $1,000 for the purchase of a thermograph of new design for determining temperature in the deep sea.

No. 195 to R. W. Hegner, University of Michigan, $160 for assistance in the study of the history of the germ cells, especially in hermaphrodite animals in order to determine the visible changes that take place in their differentiation and the causes of these changes (continuation).

The Committee on the Bache Fund at present is constituted as follows: Ross G. Harrison, Yale University; Arthur G. Webster, Clark University, and Edwin B. Frost, chairman, University of Chicago (Williams Bay, Wisconsin).

WE learn from *Nature* that the committee appointed by the Paris Academy of Sciences to examine the requests for grants from the Bonaparte Fund make the following proposals, which have been confirmed by the academy:

3,000 francs to Auguste Lameere, professor at the University of Brussels, to enable him to continue his researches at the Roscoff Zoological Station.

4,000 francs to Charles Le Morvan, assistant astronomer at the Paris Observatory, for the publication of a systematic and photographic map of the moon.

2,000 francs to Paul Vayssière, for the continuation of his researches on the various species of cochineal insects.

3,000 francs to François de Zeltner, to contribute to the cost of a proposed expedition to the Sudanese Sahara, more particularly in the Aïr massif.

2,500 francs to Léonard Bordas, to assist him in pursuing his investigations relating to insects attacking trees and forests, and more especially species which at the present time are devastating the woods of the central plateau and west of France.

3,000 francs to Joseph Bouget, botanist at the Pic du Midi Observatory, for realizing his cultural experiments on a larger scale, with special reference to the improvement of the pastures of the Pyrenees.

3,000 francs to Henry Devaux, professor of plant physiology at Bordeaux, for the continuation of his researches on the cultivation of plants in arid or semi-desert regions.

2,000 francs to Victor Piraud, for the continuation of his studies on the fauna of Alpine lakes and torrents, particularly at high altitudes.

2,000 francs to Marc Tiffeneau, for the continu-

ation of his studies on the phenomena of molecular transposition in organic chemistry.

In conformity with authorization by the minister of justice and public instruction a small expedition was despatched from the Argentine National Observatory at Córdoba to Venezuela to observe the total eclipse of the sun on February 3. The expedition is in charge of Astronomer Chaudet and is equipped with two cameras for photographing the corona, two prismatic cameras for the flash and coronal spectrum, a small slit spectrograph and a photometer. It was expected to occupy a station in or near Tucacas.

The post of mining geologist in the ministry of agriculture and commerce of China has been offered to Dr. Warren D. Smith, professor of geology in the University of Oregon. Dr. Smith went to the university in September, 1913, from the Philippines, where he was chief of the division of mines in the bureau of science. He had been in government service in the Philippines nine and a half years.

Dr. Otto Schoebl has resigned as assistant director of the quarantine laboratory, port of New York, health officers' department, to accept a position in the Bureau of Science, Manila, P. I.

Dr. William J. Means, one of the organizers of the Ohio State University and dean of the Starling-Ohio Medical University since the merger in 1907, has resigned, to take effect June 30, on account of impaired health and age.

Professor J. H. Faull, of Toronto University, recently spent nearly two weeks at the New York Botanical Garden in a study of herbarium material of the Polyporaceæ, with special reference to collections made in Ontario.

Professor H. V. Tartar, whose publications on the results of his research investigations with arsenical sprays have materially modified certain spraying practises, has been granted a two-year leave of absence as head of the Oregon Experiment Station Department of Chemistry, to pursue research work at some of the leading eastern universities.

Professor J. E. Kraus, research specialist in horticulture at the Oregon Agricultural College, has been given a two-year leave of absence to continue studies in eastern universities. He will first spend some time with the U. S. Bureau of Plant Industry investigating certain pollination problems at Miami, Florida, after which he will begin his investigational studies at Chicago.

Dr. Charles S. Pancoast, Philadelphia, who went to Vienna in December, 1914, is now in charge of a 4,000-bed hospital at Munkacz in the Carpathians.

Dr. Aylmer May, principal medical officer of northern Rhodesia, has been selected by the British war office to undertake research work on the western front in connection with wound infection.

Dr. H. M. Woodcock, assistant to the late Professor E. A. Minchin, has been appointed acting head of the department of protozoology at the Lister Institute, London.

The Minnesota and Wisconsin Chapters of the Society of Sigma Xi have established an annual exchange lectureship. For the present year President Charles R. Van Hise will represent Wisconsin in a lecture at the University of Minnesota on March 17. Professor E. M. Freeman will be the Minnesota representative in a lecture at the University of Wisconsin at some date during the second semester.

Professor William T. Councilman, of Harvard University, will lecture before the Experimental Medicine Section of the Cleveland Academy of Medicine on February 11. His subject is "Glioma."

The sixth lecture of the Harvey Society series delivered at the New York Academy of Medicine, on February 5, was by Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, on "Spirochetes."

The Guthrie lecture of the Physical Society was delivered at the Imperial College of Science on January 28, by Mr. W. B. Hardy, on the subject "Some Problems of Living Matter."

The Prussian ministry of public instruction has ordered the erection of a bust of von

Behring in the Marburg Institute for Hygiene in memory of the twenty-fifth anniversary of Behring's publication of his work on serum therapy.

ON recommendation of the council of the Biological Society of Washington the following resolution drawn up by L. O. Howard, Frederick V. Coville and Paul Bartsch has been adopted:

WHEREAS, Dr. George M. Sternberg, former Surgeon General of the U. S. Army, a distinguished worker in the biological sciences as applied to medicine, long time an active member of the Biological Society of Washington and its president during the years 1895 and 1896, has passed from this life, therefore be it

*Resolved*, That the Biological Society of Washington keenly regrets his death and offers its warmest sympathy to Mrs. Sternberg, and will always be grateful to his memory for the important part which he took in the affairs and discussions of the Society and for the distinction which his eminent name adds to its list of past-presidents.

DR. THOMAS H. RUSSELL, professor of clinical surgery in the Yale Medical School and surgeon at the New Haven General Hospital, died on February 3, at the age of sixty-three years.

DR. OSWALD KÜLPE, professor of philosophy and psychology at Munich, has died at the age of fifty-three years.

THE death is announced of Dr. Georg Grüpler, who in his laboratories at Leipzig and Dresden carried on physiological and bacteriological research in connection with the proteins, the enzymes and bacteriological stains.

THE *Medizinische Klinik* of December 26 as quoted in the *Journal* of the American Medical Association gives figures showing that the names of 1,084 physicians have appeared on the 400 casualty lists that had been published by that date in Germany. The list includes 37 civilian physicians, 377 active medical officers, 373 of the reserve force and 287 assistant medical officers. Of this total, 361 have been killed, 142 severely and 388 less severely wounded, 102 have been taken prisoners, and 90 are missing.

THE University of Colorado Mountain Laboratory, which is now in its eighth year of operation, will hold a six-weeks' session, beginning on June 26, 1916. Courses in zoology are in charge of Professor Frank Smith, of the University of Illinois; those in botany will be given by Professor Francis Ramaley, of the University of Colorado, at Boulder. The mountain laboratory does not duplicate work of the regular college year, but offers courses primarily concerned with ecology and distribution. Most of those who attend are graduate students and high-school and college instructors.

## UNIVERSITY AND EDUCATIONAL NEWS

CONTRACTS have been let recently by the board of directors of the Texas Agricultural and Mechanical College for a new hospital for which the legislature recently appropriated $50,000, and a new dairy barn to be erected at a cost of $10,000. President Bizzell has announced that plans and specifications are about completed for the new Animal Husbandry Building to cost $40,000 and a new hog cholera serum plant, for which $15,000 are now available. Professor R. Adelsperger, head of the department of architecture and architectural engineering at the college, will begin immediately on plans and specifications for the new college auditorium to be erected at a cost of $100,000 and a new Veterinary Medicine Building to cost $100,000. The funds for these two buildings will not be available until September 1, 1916.

A NEW forestry building costing $40,000 has been authorized by the board of regents and will be erected on the Oregon Agricultural College campus during the coming spring and summer. It will be a brick structure, three stories high and 80 feet wide by 140 feet long. A large laboratory for logging-engineering will be located on the first floor, with smaller laboratories for the manufacture of wood products. The second and third floors will be occupied by offices, classrooms and smaller experimental laboratories. The building will be ready for occupancy at the opening of the next college year, September, 1916.

The committee of the board of trustees of Cornell University on faculty participation in university government has recommended that three representatives of the faculty selected by ballot shall sit at meetings of the board with full powers except that of voting, and that each faculty shall select committees to meet with the general administrative committee of trustees. The board has approved in principle the second recommendation and has referred the whole question back to the committee for further conference with the faculty committee.

Dr. Willard C. Fisher, whose enforced resignation from Wesleyan University will be remembered, has been appointed acting professor of economics at New York University.

At Princeton University, E. Newton Harvey, Ph.D., has been promoted to an assistant professorship of physiology.

Professor William Stern, of Breslau, has received a call from Hamburg to fill the chair of philosophy and psychology vacant by the death of Professor Ernst Meumann.

## DISCUSSION AND CORRESPONDENCE

### PARASITES OF THE MUSKRAT

In the *Journal of Parasitology,* Vol. 2, No. 1, p. 46, Linton describes cestode cysts found in the liver and omentum of a muskrat found near Washington, Pa., in 1884. On the basis of the size and shape of the hooks and the appearance of the bladderworm Linton considers these to be *Cysticercus fasciolaris,* the larval stage of *Tænia crassicollis,* a tapeworm which is frequently found in the intestine of the cat.

The finding of *Cysticercus fasciolaris* in the muskrat has been previously reported by Stiles & Hassall, 1894, in "A Preliminary Catalogue of the Parasites Contained in the Collections of the United States Bureau of Animal Industry, United States Army Medical Museum, Biological Department of the University of Pennsylvania (Coll. Leidy) and in Coll. Stiles and Coll. Hassall."

Dr. Allen J. Smith, of the University of Pennsylvania, has written me that he has in his possession "a specimen of liver of the muskrat which is tremendously enlarged and riddled with *Cysticercus fasciolaris.*" This muskrat was trapped in the winter of 1904–05 near Philadelphia.

Among fifty muskrats examined from Nebraska and Minnesota in no case have we found the liver infected with any kind of parasite.

We have found in the intestine of one muskrat, shot at Lake Chisago, Minnesota, in August, 1915, several hundred minute monostome trematodes which represent a new species.

These two parasites should be added to the list given by us for the muskrat in Science, N.S., Vol. 42, p. 570, and the *Journal of Parasitology,* 1915, Vol. 1, pp. 184–197.

Franklin D. Barker
The University of Nebraska

### THE USE OF THE INJECTION PROCESS IN CLASS-WORK IN ZOOLOGY

It is often difficult or impossible in a laboratory class in zoology to demonstrate pathways of fluids or food in certain animals, in other than a purely structural way. Blood vessels are injected and studied as so many colored strings or tubes, and cavities and ducts are explored with a probe, leaving much to the imagination. During the summer course in zoology at the University of Cincinnati, we have made extensive use of the injection method for studying the mechanics of these structures, and their condition during operation. A glass tube is drawn out into a point of any desired size, and attached to a rubber hand bulb, either directly or by a rubber tube. This apparatus, including a bunsen burner and cutting file, is simple and cheap enough to be included as a part of each student's equipment. The injecting fluid used is usually India ink or Prussian blue. The following example will show how the method is used in studying the circulation of a freshly killed crayfish.

The animal is killed by chloroform or ether, and the carapace dissected off. The student then exposes the heart, being careful not to cut any of the surrounding tissue. A fine-pointed glass cannula is now inserted through a hole made with the point of the glass injecting

needle, or through a slit made with a scissors. Under favorable conditions, the point may be fitted into one of the ostia. The India ink is now slowly injected, and the progress of the ink watched through the transparent vessel walls. In this way, a student can realize what is meant by blood pressure, peripheral resistance of capillaries, physiological pathways open at the time of death, delicacy of capillary beds, as well as the course of the main blood vessels. There is an added advantage, in that one is able to "feel" the resistance of the vessels and capillaries, as well as to see the fluid as it passes through. The addition of a mercury manometer between the bulb and the glass tube may be of use in making quantitative or comparative studies. The advancing stream of black is carefully watched and the order in which the vessels are filled is noted. A very good idea of the relative strengths of the vessels is obtained by watching for extravasations. After these points have been observed, the injection still remains and can be studied, considerable dissection being possible without leakage. In case the ink runs on to the tissues, it can be washed off under the hydrant. The brilliant contrast of black and white is of course obvious.

A particularly instructive study can be made by injecting the venous system of the crayfish. The carapace is removed from a freshly killed specimen, and the gills exposed. The ink is then slowly injected into the ventral sinus of the abdomen. The advancing stream can be followed from the different parts of the body (well seen in the transparent joints) to the gills, through them, back to the body wall, and to the pericardial sinus. The picture seen on clearing one of the gills in glycerine has a new interest to the student, he having watched and controlled the process of filling them.

This method, besides presenting many anatomical structures from a physiological point of view, has a wide range of application. A truer, safer and more graphic picture is obtained by injecting a duct or opening, than could be secured by probing it. This is of value in some animals in tracing the bile and pancreatic ducts, as well as those of other glands. It has been successfully applied in some cases to formalin material. Thus the stomach and radial canals of *Gonionemus medusa* can be demonstrated very well, as can also the pharynx of *Amphioxus* and its relation to the atrial cavity. Formalin specimens of tapeworm show the longitudinal and connecting excretory canals very clearly. The living earthworm is very resistant to injections of the blood vessels, a point easily correlated with the fact that on cutting the worm, contraction of the vessels prevents bleeding to death. In the grasshopper, the connections between the alimentary canal and gastric ceca can be well shown by injection per os. In some cases water serves the purpose of the ink, as in studying the path of the water in the nasal aperture of the dogfish, or the change of the relations of the parts of the digestive tract when full and empty, or the resistance their inner folds presents to the passage of the food.

In these injections it should be borne in mind that the process is the part desired, not necessarily the finished product. Furthermore, the student should realize that the condition of the preserved specimen merely represents one set of conditions in the life of the animal, and the injection should therefore be considered as showing graphically the physiological condition of the animal at the time of death only, with such subsequent changes as naturally follow. This is well shown by the different amounts of ink flowing into each vessel, and the ease with which they are filled. The details noted above, while probably including points now in use in many laboratories, are given here, as we have found that the use of this technique has given the elementary student a simple means of studying, in the animals dissected in the laboratory, some of the more fundamental problems of the dynamics of organs.

RAPHAEL ISAACS
UNIVERSITY OF CINCINNATI

## THE POISONOUS CHARACTER OF ROSE CHAFERS

I WAS particularly interested in the article on this subject in SCIENCE, January 28, 1916,

because for many years past there has occurred a serious loss among the brook trout (and I think also the rainbow trout) of Pine Creek, at Long Pine, Nebraska. They have floated down stream dead, in large numbers, and stuffed with live rose chafers. The theory to account for this has been the same as stated by the above writer, namely, mechanical, though no real mechanical damage has been observed. I have no doubt of the poisonous character of the beetle, and add this note to extend the knowledge of its effects on a very different order of life. The chafers, it should be said, feed on the willows, chiefly *Salix fluviatilis*, that overhang the stream, sometimes stripping them bare.

J. M. Bates

Red Cloud, Nebraska

## SCIENTIFIC BOOKS

*British Antarctic (Terra Nova) Expedition, 1910.* Zoology, Vol. I., No. 2, *Natural History of the Adelie Penguin*, by G. Murray Levick, M.D., R.N.; No. 3, *Cetacea*, by D. G. Lillie, M.A.; Vol. II., No. 2, *Oligochæta*, by H. A. Baylis, B.A.; No. 3, *Parasitic Worms*, by R. T. Leiper, D.Sc. and E. L. Atkinson, M.D., R.N.; No. 4, *Mollusca*, Pt. 1, by Edgar A. Smith, I.S.O.; No. 5, *Nemertinea*, by H. A. Baylis, B.A.; British Museum Nat. History, 1915, 4° with many plates and text-figures.

Notwithstanding financial stringency caused by the war, and the absence of many of the younger men of science in the hospital or the trenches, British scientific institutions have been able, as a rule, to continue publication though in restricted measure. The various papers based on material collected by the *Terra Nova* expedition have been coming out separately at intervals during 1915, without reference to the order in which they are intended finally to be bound up.

Dr. Levick's account of the habits of the Adelie penguin, illustrated by twenty plates, is most interesting and some of their proceedings, especially their habit of unanimous "drilling" in large masses like a regiment of well-trained soldiers, are inexplicable on any hypothesis.

Lillie's account of the whales relates chiefly to subantarctic species mostly observed at whaling stations in New Zealand. He is disposed to regard several of the species, especially the humpback (*Megaptera nodosa* Bonnaterre), as identical with boreal species. However the coloration and proportions as figured differ markedly from the north Pacific species (*M. versabilis* Cope) and the species of *Cyamus* infesting them are distinct. He indulges in some speculations in regard to what the whalers call the "high-finned killer," individuals with a higher dorsal fin than the others of the same school, but in the north Pacific there is always at least one of these with every school of killer whales and there is little doubt that these individuals are the old parents of the family group which forms the "school."

Baylis describes a new species of *Oligocheta* found in the gill-chamber of a land crab (*Geocarcinus lagostoma* M. Edw.) collected at S. Trinidad Island in the South Atlantic. This is the second species known to inhabit such a *situs*, and does not appear to have been materially modified by its parasitic habit. Two new Nemerteans are described from the Antarctic Sea, a *Baseodiscus* and a *Lineus*, and two known species of *Amphiporus* were also obtained, while three other species were obtained in New Zealand waters.

The parasitic worms described by Leiper were chiefly obtained from seals and fishes, the birds proving almost free from parasites. A free living Nematode was dredged in McMurdo Sound in 250 fathoms. The species are well illustrated and the paper concludes with a summary of the species collected by previous Antarctic expeditions.

The Prosobranch, Scaphopod and Pelecypod mollusca are described with his usual care by Edgar A. Smith and illustrated by two excellent plates. Fifty-eight species are enumerated from the Antarctic region of which twelve are new.

The expeditions of the *Discovery* and *Southern Cross* had previously obtained a large proportion of the fauna of the region visited by the *Terra Nova*. Nothing very striking appears among the novelties except one or two

odd forms referred to *Trichotropis*. A new species of *Neoconcha* has a strong resemblance to *Torellia*. *Modiolaria lateralis* Say, originally described from the Florida coast, was obtained from South Trinidad Island, 700 miles off the coast of Brazil in the South Atlantic.

WM. H. DALL

## PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

(VOLUME 2, NUMBER 1)

THE first number of volume 2 of the *Proceedings of the National Academy of Sciences* contains the following articles:

1. *A Possible Origin for Some Spiral Nebulæ:* G. F. BECKER, United States Geological Survey, Washington.

It is suggested that nebulæ may be developed from nebulous streamers or "bacula." Comparison of the theoretical shape of the nebulæ at certain stages of their development with the Whirlpool nebula is not unfavorable to the hypothesis.

2. *A Peculiar Clay from near the City of Mexico:* E. W. HILGARD, University of California.

The analysis shows that the predominant base is magnesia. A peculiarity of the clay is its exceptionally high absorptive power for water.

3. *Studies of Magnitude in Star Clusters,* I. *On the Absorption of Light in Space:* HARLOW SHAPLEY, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

The examination of the Hercules cluster indicates the conclusion that the selective extinction of light in space is entirely inappreciable and that probably the non-selective absorption in space is also negligible.

4. *Studies of Magnitudes in Star Clusters,* II. *On the Sequence of Spectral Types in Stellar Evolution:* HARLOW SHAPLEY, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

The giant second-type stars are present in large numbers in the globular clusters. The results offer difficulties for the conventional scheme of evolution of spectral types, but the difficulties are not so severe for Russell's hypothesis.

5. *Experimental Evidence for the Essential Identity of the Selective and Normal Photo-Electric Effects:* R. A. MILLIKAN and W. H. SOUDER, Ryerson Physical Laboratory, University of Chicago.

Photo-electric phenomena are not in general conditioned by the presence of a gas. All distinctions between the normal and selective effects in lithium have disappeared.

6. *Concomitant Changes in Terrestrial Magnetism and Solar Radiation:* L. A. BAUER, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

Changes in the earth's magnetism of appreciable amount are found associated with changes in solar radiation. Decreased solar constant is accompanied by increased magnetic constant. Various minor but important correlations are established.

7. *Submarine Solution of Limestone in Relation to the Murray-Agassiz Theory of Coral Atolls:* A. G. MAYER, Department of Marine Biology, Carnegie Institution of Washington.

By exposing pieces of shell of the mollusc *Cassis* to solution in sea-water for a year under various conditions, it is shown that the rate of solution is too slow to be favorable to the theory that the solvent action of sea-water for limestone is a primary factor in deepening and widening the lagoons of coral atolls.

8. *The Archegonium and Sporophyte of Treubia Insignis Goebel:* D. H. CAMPBELL, Department of Botany, Stanford University.

*Treubia* is probably on the whole nearer the leafy liverworts than is any other anacrogynous genus.

9. *Brief Notes on Recent Anthropological Explorations under the Auspices of the Smithsonian Institution and the U. S. National Museum:* ALEŠ HRDLIČKA, Division of Physical Anthropology, U. S. National Museum.

The topics treated are: Search for Neolithic Human Remains in Southwestern Russia;

Explorations in the Birusa Caves and Rock Shelters on the Yenisei River, Siberia; Development of the Child among the Negrito, the African Negro, the Eskimo, and Native Siberians.

10. *A Theory of Nerve-Conduction:* A. G. Mayer, Department of Marine Biology, Carnegie Institution of Washington.

The theory of nerve-conduction is based upon the phenomena of adsorption. The results lend no support to the theory that the velocity of propagation of nerve impulse is that of a shear in the substance of the nerve.

11. *Zuñi Culture Sequences:* A. L. Kroeber, Museum of the Affiliated Colleges, San Francisco.

The author gathered a large number of potsherds in and near Zuñi, and is able to make a tentative chronological classification of the objects.

12. *The Numerical Results of Diverse Systems of Breeding:* H. S. Jennings, Zoological Laboratory, Johns Hopkins University.

The proportions of the population which are found after $n$ generations arising from continued breeding in various ways are tabulated for 24 different methods of mating.

13. *On the Effects of Feeding Pituitary Body (Anterior Lobe) Substance, and Corpus Luteum Substance to Growing Chicks:* Raymond Pearl, Biological Laboratory, Maine Agricultural Experiment Station.

The commencement of the laying period in pullets is neither retarded nor accelerated by feeding pituitary and corpus substance, but the body growth is retarded.

14. *A Preliminary Report on Further Experiments in Inheritance and Determination of Sex:* Richard Goldschmidt, Osborn Zoological Laboratory, Yale University.

The article states a number of new results found by the author in continuing his earlier work on the interbreeding of gypsy moths. Every gradation of intersexualism from a normal female to a normal male, and from a male three-fourths of the way toward the female has been obtained.

15. *On the Degree of Inbreeding which exists in American Jersey Cattle:* Raymond Pearl and S. W. Patterson, Biological Laboratory, Maine Agricultural Experiment Station.

American Jersey cattle are about one half as intensely inbred when eight generations are taken into account as would be the case if continued brother $\times$ sister breeding had been followed. In general, Register of Merit animals are *less* intensely inbred than the ordinary population.

16. *Upper Limit of the Degree of Transitivity of a Substitution Group:* G. A. Miller, Department of Mathematics, University of Illinois.

The degree of transitivity of a substitution group of degree $n$ which does not include the alternating group of this degree is always less than $\frac{5}{2}\sqrt{n}-1$.

17. *The Extension of the Montana Phosphate Deposits Northward into Canada:* F. D. Adams and W. J. Dick, Commission of Conservation of Canada.

An account of the explorations carried out to ascertain whether phosphate-bearing rocks extend northward from Utah, Idaho, and Montana into Canada. In some places such an extension has been found.

Edwin Bidwell Wilson
Mass. Inst. of Tech.

## NOTES ON METEOROLOGY AND CLIMATOLOGY

### SNOWFALL AND SNOW COVER

The destructive snowstorm of December 13, 1915, in the vicinity of New York showed strikingly the ocean control on the depth of snowfall. While the precipitation (rain and melted snow) was heavy everywhere, the depth of snowfall, according to press reports, ranged from little or nothing in eastern Massachusetts to one foot between New York and New Haven and two feet near Albany. The warmth of the ocean effectively prevented snowfall where the winds blew off the water and made it sticky and dense near the coast, even though the surface wind was from the north. Not until February or March does heavy snowfall usually occur with winds from the ocean. A

discussion with maps of the snowfall of the eastern United States was published by C. F. Brooks in the *Monthly Weather Review*, June, 1914, and January, 1915.

Snowstorms of the eastern United States are difficult to forecast, because a sleet or ice storm frequently occurs instead. Professor H. C. Frankenfield, of the Weather Bureau, has recently made a study of the temperatures preceding sleet and snow storms.[1] Steep temperature gradients northward, and high temperatures over the Gulf and south Atlantic states are necessary for sleet formation and usually absent before and during heavy snows.

The heavy snowfall problem in mountains of the west is discussed by A. H. Palmer in a well-illustrated paper, "The Region of Greatest Snowfall in the United States."[2]

Tamarack, and Summit, California, have the greatest observed snowfall in the United States.

| Station | County | Watershed | Altitude (Feet) | Length of Record (Years) | Annual Snowfall (Inches) | | | Total Rain and Melted Snow (Inches) |
|---|---|---|---|---|---|---|---|---|
| | | | | | Average | Max. | Min. | |
| Tamarack..... | Alpine | San Joaquin | 8,000 | 8 | 521 | 757 | ..... | 57.5 |
| Summit..... | Placer | Sacramento | 7,017 | 44 | 420 | 783<br>776 | 154 | 48.1 |

During heavy snowfall the wind is usually relatively light, in marked contrast to the windy snowstorms of the east. The pressure of the snow on any raised objects becomes very great. A fence made of two-inch boiler flues has been bent; the snow sheds, even where built of twelve- by fourteen-inch timbers occasionally collapse, and the gables of the houses are steep to prevent similar crushing.[3] For thirty-two miles, from Blue Canyon to Truckee, expensive snow sheds are required to protect the Southern Pacific tracks from the snowfall and avalanches.

DEPTH OF SNOW ON GROUND (9-YEAR AVERAGE) (INCHES)

| | Dec. 1 | Jan. 1 | Feb. 1 | Mar. 1 | Mar. 15 | Mar. 31 |
|---|---|---|---|---|---|---|
| T ..... | 19 | 62 | 165 | 183 | 194 | 192 |
| S ..... | 9 | 44 | 122 | 127 | 140 | 118 |

Mountain snowfall is of immense value for water power and for irrigation; and to some extent this value is controlled by the rate of melting. Messrs. A. J. Jaenicke and M. H. Foerster have written an article on "The Influence of a Western Yellow Pine Forest on the Accumulation and Melting of Snow."[4] Five years of records near Flagstaff, Arizona, indicate that the snowfall in the forest and adjacent grass and farm land park is same; but that the rate of melting is different. In the park the minimum temperatures are lower and the maxima are higher than those in the forest. Thus the soil in the park is generally frozen before the winter snow cover is established, while in the forest the soil may freeze only in a few spots. Any water from melting snow in winter forms an ice layer at the base of the snow cover in the park, but sinks into the ground in the forest. In winter on account of the generally higher temperatures and the heating of the local bare spots and trees, the snow melts more rapidly in the forest than in the park. In spring, on the contrary, the formation of slush, the strong sunshine, and higher wind velocity in the park cause the snow to melt a week, or even more than two weeks, before the last drifts of snow in the forest. The frozen soil and the basal ice layer in the park allow the water to run off very rapidly, while only occasionally is there any surface run-off in the forest. The value of open forest for water conservation is evident.

[1] "Sleet and Ice Storms in the United States," Second Pan-American Scientific Congress.

[2] *Mo. Weather Rev.*, May, 1915. See map of the snowfall of the United States by C. F. Brooks, *Quar. Jour. Roy. Meteorological Soc.*, April, 1913.

[3] Note the destructive effect of the heavy snowfall at Flagstaff, Arizona, December 29–31, 1915.

[4] *Mo. Weather Rev.*, March, 1915.

In order to estimate the water from mountain snowfall which will become available in summer, snow surveys are made every spring in the mountains of the west. Type watersheds are surveyed; and the snow is estimated on adjacent ones. The use of a snow sampler gives best results. Several sections of tubing of small diameter are used to cut vertical snow cylinders. This is done at a great many points; and the water content of the snow determined by weight.[5]

### WEST INDIA HURRICANES

Two very intense tropical cyclones visited the gulf coast in August and September, 1915, the first taking its greatest toll of life in Texas and the second in Louisiana. The 1915 Galveston storm made its appearance the morning of August 10 between Dominica and the Windward Islands of Barbados. The storm on passing Haiti, Jamaica and Cape San Antonio, Cuba, did immense damage to the banana and sugar crops; and sank one large steamer. In Texas the loss of life was 275; and in the severe floods occasioned as far as the Ohio Valley 30 were drowned. The cyclone passed out the St. Lawrence Valley August 23. The lowest pressure reading (reduced to sea level) was 28.20 inches (955.6 kb. or mb.) at Houston; the highest wind velocity for five minutes was 93 miles per hour, at Galveston. While the high tide at Galveston was about the same as in 1900, less damage resulted owing to the protection afforded by the sea wall and the elevation of part of the city.

The land winds on the coast of southern Texas brought on the highest temperatures ever recorded at Brownsville (104° F.), and Corpus Christi (100° F.). In Texas the central calm of the cyclone was about 6 miles in diameter, and its forward movement was 15 miles per hour.[6]

One of the most thorough studies ever made of a tropical cyclone was that conducted by Dr. I. M. Cline of the Weather Bureau at New Orleans, September 29, 1915.[7] The storm originated near 64° W. longitude in the Caribbean Sea September 23 and passed over New Orleans six day later. The sea level pressure minimum of 28.11 inches (952.5 kb. or mb.) at New Orleans established a new low record for the United States; and the winds attained tremendous velocities. At New Orleans the maximum for 5 minues was 86 miles per hour, and for half a minute, 130. At Burrwood, Louisiana, where the wind had an unobstructed sweep, the average velocity for 3 hours was 103 miles per hour, reaching 116 for 20 minutes, 124 for 5 minutes, and for about half a minute the rate of 140 miles per hour. While there may be doubt as to the accuracy of the cup anemometer, these figures give some quantitative measurement of the tremendous violence of the wind. The wind is described as coming in a series of puffs of a few seconds' duration. The wind did not veer gradually but changed suddenly from one point to the next; and just before each change the rainfall was intense. So violent was the wind that probably no house in New Orleans escaped damage. The total rainfall at New Orleans was 8.20 inches, but was as high as 14.43 in Washington County. Fifty miles west of the center the rainfall was negligible. The pressure gradient was 1 inch (33.9 kb. or mb.) in 50 miles. The central calm was about 8 miles and the whole storm (pressure below 29.50 (999.3 kb. or mb.)) 250–300 miles in diameter; and it progressed at about 12 miles an hour. The high tide overtopped the levees south of New Orleans and on the north overflowed from Lake Ponchartrain into the western part of the city. The loss of life was probably 275, and of property $13,000,000, of which a third was in New Orleans. The westerly course of both hurricanes was due apparently to the presence of high pressure areas in the east central United States. The relatively small loss of life in two such intense hurricanes is due largely to the ample warnings given by the United States Weather Bureau.

The weather immediately preceding the formation of a West India hurricane is usually hot, damp and calm. The region of origin is

[5] Professor J. E. Church, University of Nevada, Second Pan-American Scientific Congress.

[6] See *Mo. Weather Review*, August, 1915.

[7] See *Mo. Weather Rev.*, September, 1915.

generally in the west early and in the east in the middle of the season. According to Sr. J. C. Millas (Second Pan-American Scientific Congress) the original impulse which sets the air in rotation may come from winds at the level of the intermediate clouds. Thus the cyclones are probably largely convectional in origin but to some extent dynamical.

### CLIMATIC SUBDIVISIONS OF THE UNITED STATES[8]

PROFESSOR R. DEC. WARD, after treating earlier and present climate subdivisions of the United States, proposes a new scheme based on the following principles:

> . . . the subdivisions should be chosen because of their special relations to cyclonic and anticyclonic tracks and movement; to local and characteristic weather distribution around lows and highs; to cyclonic and anticyclonic winds; and because of general similarity of weather types over each province. Finally, the districts should, as far as possible, be the same as those which have been officially adopted in the publication of the meteorological and climatic data of the region.

He makes eight provinces. The Eastern Province includes all the eastern United States except for the Gulf Province, a strip along the southern coasts extending inland about 200 miles from the Gulf of Mexico. The two Plains provinces have their eastern boundary roughly set at the 100th meridian—more exactly on the 2,000-foot contour. The two Plateau provinces begin at the main crest of the Rockies and the two Pacific provinces occupy the region west of the crests of the Sierra Nevadas and Cascades. The line dividing the northern from the southern Pacific, Plateau and Plains provinces follows in general the southern boundaries of Oregon, Idaho, Wyoming and Nebraska. These serviceable subdivisions not only follow Professor Ward's specifications, but also can be easily remembered.

## NOTES

THE *Monthly Weather Review* under the acting editorship of Professor Cleveland Abbe, Jr., has become a comprehensive meteorological magazine international in scope. It contains in addition to direct meteorological contributions from Americans and foreigners many reprints and abstracts of important meteorological papers which have appeared elsewhere. The Weather Bureau library under the direction of Professor C. F. Talman contributes not only its monthly list of publications received and of papers bearing on meteorology, but also notes of general interest.

"A LIST of Meteorological Isograms," is the title of one such note by Professor Talman.[9]

> The term "Isogram" was suggested by Francis Galton in 1889 as a convenient generic designation for lines, on a chart or diagram indicating equality of some physical condition or quantity. . . . The largest number of those to which particular names have been assigned belong to meteorology.

The list of 90 such isograms includes the author of each term and the earliest instance of its use, so far as this information could be obtained by the compiler. Most of the terms are rarely used.

MISS E. BUYNITZKY, of the library, has contributed a "Tentative Classification for Meteorological Literature."[10] This is based on schedule F of the International Catalogue of Scientific Literature, but in general form is like the Dewey decimal system. The main divisions are as follows:

00 General Works.
10 Observatories. Methods of observation.
20 Instruments.
30 Physics of the atmosphere. Cosmical relations. Aerology.
40 Pressure.
50 Temperature. Radiation.
60 Atmospheric moisture.
70 Circulation of the atmosphere.
80 Atmospheric electricity.
90 Climate and weather.

There are 81 main heads and 71 subheads; and it is easy to add more. A few minor rearrange-

[8] *Bulletin of the Am. Geog. Soc.*, September, 1915, pp. 672–680. Condensed in *Mo. Weather Rev.*, September, 1915, pp. 467–468.

[9] *Mo. Weather Rev.*, April, 1915, pp. 195–198.

[10] *Mo. Weather Rev.*, September, 1915, pp. 362–364.

ments might be made to advantage; for instance, ice storms should be associated with sleet instead of with dew and frost; and percolation perhaps belongs with the relations of precipitation and vegetation to water supply and stream flow, rather than to the section of atmospheric precipitation. This classification is less complete, but more easily remembered than the International; and, being more recent than either the International or the Dewey systems, it meets in a satisfactory way the general requirements of modern meteorological literature.

Mr. Robert Seyboth has compiled a valuable list of the "Serial Numbers of Weather Bureau Publications."[11] The numbers begin with 60 in 1895 and end with 560, the *Monthly Weather Review* for July, 1915. The list embraces the vast majority of Weather Bureau publications, and, in addition, the important unnumbered publications are mentioned.

Professor A. J. Herbertson died July 30, 1915, at the age of 50 years. He is noted in meteorology particularly for his contribution, "The Distribution of Rainfall Over the Land," compiled for the Royal Geographical Society in 1900, and for his editorship of the Oxford Wall Maps.

Mr. Walter G. Davis, director of the Oficina Meteorologica Argentina for more than 30 years, has retired on a pension. Mr. George Wiggin, a native of New Hampshire, for 21 years assistant director, is now acting director.

Charles F. Brooks

Yale University,
January 3, 1915

## SPECIAL ARTICLES

### THE DEVELOPMENT OF THE PHYLLOXERA VASATRIX LEAF GALL

In Bulletin 209, recently issued by the United States Department of Agriculture, entitled "Testing Grape Varieties in the Vinifera Regions of the United States," Husmann makes the following statements, p. 12:

> The number of swellings, nodosities and tuberosities from insect punctures and the rotting of the root occasioned by them progress more or less rapidly and deeply in accordance with the texture and character of the root attacked. The weakening and ultimate death of the vine are determined by the extent of the punctures and the progress of the rot upon the roots.

Although Cook suggested that puncturing may be the stimulus for the gall production occasioned by the aphids, no evidence has ever been presented to confirm this theory. To the contrary, after intensive study of the grape-vine leaf gall produced by this insect, the writer has gathered evidence showing that so little puncturing is done by the insect that, as a gall-producing stimulus traumatic puncturing may be regarded as playing a very minor part. Histological sections of leaves attacked by *Phylloxera* readily reveal the actual puncturing done by the insect. This manifests itself in the broken-up condition of the epidermal and mesophyll cells through which the proboscis has passed. In a considerable number of slides, microscopic examination shows the proboscis itself passing through the punctured and broken-up cells. The writer has never found more than two or three epidermal cells and as many mesophyll cells thus ruptured. So slight a disturbance can not be looked upon as the main cause of such large hyperplastic growths as are produced on the leaves of the vine or on the roots of the vine. This view is substantiated by Cornu's excellent work upon the root swellings induced by the attacks of this insect.

The one thing that is definitely certain about the work of *Phylloxera* is the fact that it obtains its food by means of a sucking action. This action usually continues for about 12 to 15 days at one particular point on the leaf, and around this point, which may be called the sucking center, the gall develops. During this time the insect has obtained enough food to enable it to sustain itself, to increase its bulk considerably, and to produce several hundred eggs. The withdrawal of so much food at one point from tender growing leaves, the subsequent changes in tension and pressure at this point, and certain structural peculiarities of the gall itself, all suggest the

[11] *Mo. Weather Rev.*, July, 1915, pp. 346–350.

sucking action as the initial stimulus for gall production.

HARRY R. ROSEN

U. S. NATIONAL MUSEUM

## THE QUARTER-CENTENNIAL ANNIVERSARY OF THE OHIO ACADEMY OF SCIENCES

THE twenty-fifth annual meeting of the Ohio Academy of Science was held at the Ohio State University, Columbus, on Friday and Saturday, November 26 and 27, 1915, under the presidency of Professor J. Warren Smith, of Columbus.

Owing to the anniversary character of the meeting the usual program of volunteer papers was replaced by a series of invited addresses, as follows:

Presidential Address, "Agricultural Meteorology," Professor J. Warren Smith, United States Weather Bureau, Columbus.

"Applied Meteorology and the Work of the Weather Bureau," Dr. Charles F. Marvin, Chief United States Weather Bureau, Washington, D. C.

"The Relation of the Academy to the State and to the People of the State," Dr. T. C. Mendenhall, Ravenna.

"Historical Sketch of the Ohio Academy of Science," Professor William R. Lazenby, Ohio State University, Columbus.

Reviews of Scientific Progress in the Quarter Century:

"Geology," Professor Frank Carney, Denison University, Granville.

"Botany," Professor Bruce Fink, Miami University, Oxford.

"Physics," Professor Frank P. Whitman, Western Reserve University, Cleveland.

"Zoology," Professor Edward L. Rice, Ohio Wesleyan University, Delaware.

"Chemistry," Professor William McPherson, Ohio State University, Columbus.

"Archeology," Professor G. Frederick Wright, Oberlin College, Oberlin.

At the supper, held on Friday evening at the Ohio Union, short addresses were given by visiting delegates from other scientific societies. Governor Willis had expected to be present and to speak, but was unavoidably prevented at the last moment.

Notice was received of the appointment of the following delegates; those marked with the asterisk were present at the meeting.

American Association for the Advancement of Science,
*Professor L. O. Howard, Washington, D. C.
Boston Society of Natural History,
*Professor Frederick C. Waite, Cleveland, O.
Chicago Academy of Science,
Dr. Frank C. Baker, Chicago, Ill.
Indiana Academy of Science,
*Dr. D. W. Dennis, Richmond, Ind.
Mr. E. B. Williamson, Bluffton, Ind.
Iowa Academy of Science,
*Professor Herbert Osborn, Columbus, O.
Dr. Charles R. Keyes, Des Moines, Ia.
New York Academy of Science,
Mr. Emerson McMillin, New York City.
Professor H. P. Cushing, Cleveland, O.
Academy of Natural Sciences of Philadelphia,
Dr. Howard Ayers, Cincinnati, O.
Washington Academy of Sciences,
*Professor Dayton C. Miller, Cleveland, O.
*Dr. Charles F. Marvin, Washington, D. C.
Cincinnati Section of the American Chemical Society,
Dr. Lauder W. Jones, Cincinnati, O.
Dr. Alfred Springer, Cincinnati, O.
Cincinnati Society of Natural History,
Dr. DeLisle Stewart, Cincinnati, O.
Columbus Audubon Society,
*Professor J. C. Hambleton, Columbus, O.
Miss Lucy Stone, Columbus, O.
Denison Scientific Association,
*Dr. George Fitch McKibben, Granville, O.
*Mr. Charles W. Henderson, Granville, O.
Wooster University Scientific Club,
*Mr. Frank H. McCombs, Wooster, O.
The Cuvier Press Club,
Mr. James W. Faulkner, Cincinnati, O.
Association of Ohio Teachers of Mathematics and Science,
*Professor S. E. Rasor, Columbus, O.
Ohio State University Scientific Association,
Professor Karl D. Swartzel, Columbus, O.
*Professor James R. Withrow, Columbus, O.
Oxford Science Club,
*Professor J. A. Culler, Oxford, O.
Otterbein Science Club,
*Mr. Richard M. Bradfield, Westerville, O.
Baldwin-Wallace Science Seminar,
*Professor E. L. Fullmer, Berea, O.

The following members of the old Tyndall Association, so potent in the scientific life of Columbus and Ohio in the seventies and eighties, were also present by special invitation:

Mr. H. N. P. Dole, Columbus, O.
Mr. Martin Hensel, Columbus, O.

Mr. Curtis C. Howard, Columbus, O.
Professor William R. Lazenby, Columbus, O.
Dr. C. L. Mees, Terre Haute, Ind.
Dr. T. C. Mendenhall, Ravenna, O.
Dr. Sidney A. Norton, Columbus, O.
Mr. D. E. Williams, Columbus, O.

In the business session the most notable action was the adoption of a constitutional amendment, suggested at the previous annual meeting, by which the date of the annual meeting is changed from Thanksgiving to March or April, the exact date to be fixed by the executive committee. By vote of the academy the next meeting will be held in the spring of 1916.

The trustees of the research fund announced a further gift by Mr. Emerson McMillin, of New York, of $250 for the encouragement of the research work of the academy.

As a result of the suggestions contained in the address by Dr. Mendenhall, on "The Relation of the Academy to the State and to the People of the State," a committee on legislation was appointed, consisting of Dr. T. C. Mendenhall, chairman, Professor F. C. Waite and Professor Herbert Osborn.

The previous affiliation of the academy with the *Ohio Journal of Science* was continued with minor modifications; but the incoming president was instructed to appoint a committee to confer with the committee on legislation and to "investigate carefully possible ways and means whereby the academy can successfully take over the *Ohio Journal of Science* and how soon this can be done, the committee to report back to the academy at its next annual meeting." President Hubbard appointed Professor J. Warren Smith, chairman, Professor Frank Carney, Professor F. C. Waite, Professor J. S. Hine and Professor C. G. Shatzer.

Forty-one new members were elected at the meeting.

The officers and standing committees for 1915–1916 will be as follows:

*President*—Professor G. D. Hubbard, Oberlin College.

*Vice-president for Zoology*—Professor F. L. Landacre, Ohio State University.

*Vice-president for Botany*—Professor M. E. Stickney, Denison University.

*Vice-president for Geology*—Professor T. M. Hills, Ohio State University.

*Vice-president for Physics*—Professor L. T. More, University of Cincinnati.

*Secretary*—Professor E. L. Rice, Ohio Wesleyan University.

*Treasurer*—Professor J. S. Hine, Ohio State University.

*Executive Committee,* together with the president, secretary and treasurer, members *ex-officio*—Professor L. B. Walton, Kenyon College, and Professor C. G. Shatzer, Wittenberg College.

*Trustees of Research Fund*—Professor W. R. Lazenby, Ohio State University; Professor M. M. Metcalf, Oberlin College; Professor N. M. Fenneman, University of Cincinnati.

*Publication Committee*—Professor J. H. Schaffner, Ohio State University; Professor C. H. Lake, Hamilton; Professor L. B. Walton, Kenyon College.

*Library Committee*—Professor W. C. Mills, Ohio State University; Professor F. O. Grover, Oberlin College; Professor J. A. Culler, Miami University.

Edward L. Rice,
*Secretary*

Delaware, Ohio

## THE TENNESSEE ACADEMY OF SCIENCE

The sixth meeting (fourth annual meeting) of the Tennessee Academy of Science was held on November 26, 1915, at George Peabody College for Teachers, Nashville, Tenn. President W. E. Myer presided. The following papers were read and discussed:

"Why Potteries should be Established in West Tennessee," by Wilbur A. Nelson.

"Preservation of Our Forests," by R. S. Maddox.

"Cause of the Stylolitic Structure in the Tennessee Marble," by C. H. Gordon.

"Phosphate Rocks of Johnson County, Tenn.," by Olaf P. Jenkins.

"The Evolution of Mississippi River Craft as Influenced by Geographic Conditions," by Charles C. Colby.

"Recent Results in Mathematical Astronomy," by H. E. Buchanan.

"An Irrigation Slide for Prolonged Observation of Living Aquatics"; (*b*) "A Simple Device for Aerating Aquaria"; by Samuel M. Bain.

"Guessing as Influenced by Odd Numbers," by F. B. Dresslar.

"Nature and Origin of the Holston Marble Formation in East Tennessee," by C. H. Gordon.

"The Ordination of Sciences in Education," by R. I. Raymond.

Memorial Sketches of Deceased Members: (*a*) "Dr. William L. Dudley," by L. C. Glenn; (*b*)

"Dr. James A. Lyon," by J. I. D. Hinds; (*c*) "Mr. James H. Baird," by S. Cecil Ewing.

Annual address of the president: "The Probable Origin of the American Indian," by W. E. Myer.

The election of officers for the ensuing year resulted as follows:

*President,* Samuel M. Bain, University of Tennessee, Knoxville, Tenn.

*Vice-president,* Samuel M. Barton, University of the South, Sewanee, Tenn.

*Secretary,* Roscoe Nunn, U. S. Weather Bureau, 1235 Stahlman Building, Nashville, Tenn.

*Treasurer,* Archibald Belcher, Middle Tennessee State Normal School, Murfreesboro, Tenn.

*Editor,* A. H. Purdue, State Geological Survey, Nashville, Tenn.

The president appointed as members of the executive committee, J. I. D. Hinds, Castle Heights School, Lebanon, Tenn., and F. B. Dresslar, George Peabody College for Teachers, Nashville, Tenn.

ROSCOE NUNN,
*Secretary*

NASHVILLE, TENN.

## SOCIETIES AND ACADEMIES

### THE BOTANICAL SOCIETY OF WASHINGTON

THE one hundred and sixth regular meeting of the Botanical Society of Washington was held in the assembly hall of the Cosmos Club at 8 P.M., October 5, 1915. Thirty members and two guests were present. The following scientific program was given:

*Some Recent Investigations in Sugar-beet Breeding* (with lantern): MR. F. J. PRITCHARD.

The speaker presented a large number of tables and figures based upon ten years' experiments in sugar-beet breeding from which the following conclusions were drawn: Differences in the size, total sugar content and percentage of sugar of individual beet roots show no evidence of inheritance. There is no correlation between percentage or quantity of sugar of roots of ordinary sizes and their yield of seed, nor between their yield of seed and the average percentage of sugar in their progeny. Fluctuations in percentage and yield of sugar of beet families planted in progeny rows in alternation with check rows greatly exceed their real differences. The discontinuance of selection for one generation caused no deterioration, but some apparent gain in percentage of sugar. No improvement was obtained in yield or percentage of sugar from continuous selection. Both the good and the poor families transmitted average qualities. Fluctuations in percentage and yield of sugar are caused chiefly by irregularities of the soil. The nutritive conditions which favor the production of a large root cause a large tonnage of beets, but a low percentage of sugar. Even with a uniform stand certain rows and certain parts of the field produce a relatively small root and consequently a high percentage of sugar, while neighboring areas produce a large root and a low percentage of sugar. As the fluctuations in percentage and yield of sugar are large, they obscure real differences between varieties or families but real differences may be distinguished by planting each variety or family a large number of times.

*Notes on Plant Parasitic Nematodes* (with lantern): MR. L. P. BYARS.

After a few introductory remarks concerning the general characteristics of the three groups of nematodes—the free living, animal parasitic, and plant parasitic—the speaker indicated some of the more important anatomical and life-history features of species belonging to the last group. Emphasis was laid on the economic importance of and present distribution of *Tylenchus dipsaci,* the bulb and stem-infesting nematode; *Tylenchus tritici,* a nematode living in wheat kernels; *Aphelenchus armerodis,* the violet bud organism; and *Heterodera radicicola,* the gall-forming nematode, all of which are parasites introduced into this country. Illustrations and drawings were used to show the speaker's method of growing *Heterodera radicicola* in pure culture, and to indicate the effect of this parasite on its host.

*The First Washington Botanical Society:* MR. P. L. RICKER.

While collecting material for the bibliography and biography in the forthcoming Flora of Washington I first learned[1] of the existence of a Washington Botanical Society organized on March 13, 1817, with thirteen charter members, consisting of John Boyle, W. A. Bradley, Dr. John A. Brereton, Samuel Elliot, Jr., William Elliot, J. W. Hand, Dr. Henry Huntt, Maj. James Kearney, Rev. Dr. James Laurie, Dr. Alexander McWilliams, J. M. Moore, John Underwood and George Watterson. Subsequently six additional mem-

[1] Coville, Frederick V., "Early Botanical Activity in the District of Columbia." Records of the Columbia Historical Society, 5: 176–194. 1901.

bers were elected and three honorary members, consisting of Dr. Jacob Bigelow, Dr. William Darlington and Dr. William P. C. Barton. Meetings of the society were held until March 27, 1826, when the society adjourned sine die. It was ordered that the library of the society be deposited in the Washington Library. The herbarium was placed under the care of Dr. McWilliams, but its subsequent disposition has not been learned. The records of the society eventually found their way into a local second-hand book store and were presented to the late Dr. Lester F. Ward in 1883, remaining in his possession until his death, when his library was given to Brown University. After correspondence with the librarian of Brown University to learn if the records were there, formal request was made to the trustees of Brown University by the secretary of this society for the return of the records to Washington, which request was granted. The proceedings of the meetings for the first few years show considerable progress in the study of the local flora and offer much interesting historical data.

The fifteenth annual meeting of the Botanical Society of Washington was held in Room 33, West Wing, New Department of Agriculture Building at 1:30 P.M., October 19, 1915, with twenty-four members present. The report of the executive committee showed the following facts concerning the activities of the society for the preceding year: Average attendance of seventy-three members and guests. Seven members were lost during the year, one by resignation and six by change of residence. Eighteen new members were elected, making a total net membership of one hundred and forty-three. One joint meeting was held with the Washington Academy of Sciences. Twenty-one formal scientific papers were presented and the following visiting botanists were entertained: Professor J. C. Bose, Drs. Camillo Schneider, F. Kolpin Ravn, Otto Appel and Gentaro Yamada.

The customary reports were presented and approved and the following officers elected for the ensuing year: *President,* Professor A. S. Hitchcock; *Vice-president,* Dr. J. W. T. Duvel; *Recording Secretary,* Chas. E. Chambliss; *Corresponding Secretary,* W. E. Safford; *Treasurer,* Dr. C. E. Leighty; *Vice-president in Washington Academy of Sciences,* Dr. R. H. True.

Perley Spaulding,
*Corresponding Secretary*

## THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the 490th meeting of the society, held November 2, 1915, Dr. Walter Hough spoke on "Progress in Anthropology in California." He showed how means of transportation and food and water supplies influenced the direction of migrations in California. The entire Pacific coast was described as a swarming place of tribes offering perplexing problems to the ethnologist. Among others, Bancroft, Lummis and Cowan, have made contributions in this field. The great museum collections in San Francisco and Los Angeles were described and the important researches of Kroeber and others at the University of California; also a study of the 400 shell mounds of San Francisco bay made by Gifford, Nelson and Waterman. The exhibits at the expositions have been previously described before the society.

At the 491st meeting of the society, held December 7, 1915, Mr. Francis LaFlesche read a paper on the "Right and Left in Osage Rites." The Osage, in the early days of their tribal organization, believed that all life proceeded from the fructifying union of the sky and the earth and founded their gentile organization upon this concept. They divided the people into two parts, the "Tsi-zhu" (household), representing the sky, and the "Ho$^{n}$-ga" (sacred), representing the earth. They likened the tribe to a living man facing the east, the Tsi-zhu division being on the north, the Ho$^{n}$-ga on the south. When organizing a war party, however, the position of the village was changed so that the symbolic man faced to the west. All ceremonial movements were made with reference to the right and left sides. The same idea determined the placing of symbolic articles used in the ceremony and appeared in the daily customs of the people.

In discussing the paper, Miss Alice C. Fletcher and Messrs. Hodge, Swanton, Fewkes, Mooney and Michelson referred to similar concepts and organizations in other tribes, as among the Hopi of the south and the Piegan of the north. Several thought that the origin of 6 as a ceremonial and sacred number had reference to the six "cardinal points," north, south, east, west, up, and down. Explanations were also suggested for the preference given the left hand in these ceremonies. The sky concept possibly had a religious significance.

Daniel Folkmar,
*Secretary*